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SCIENTIFIC AMERICAN

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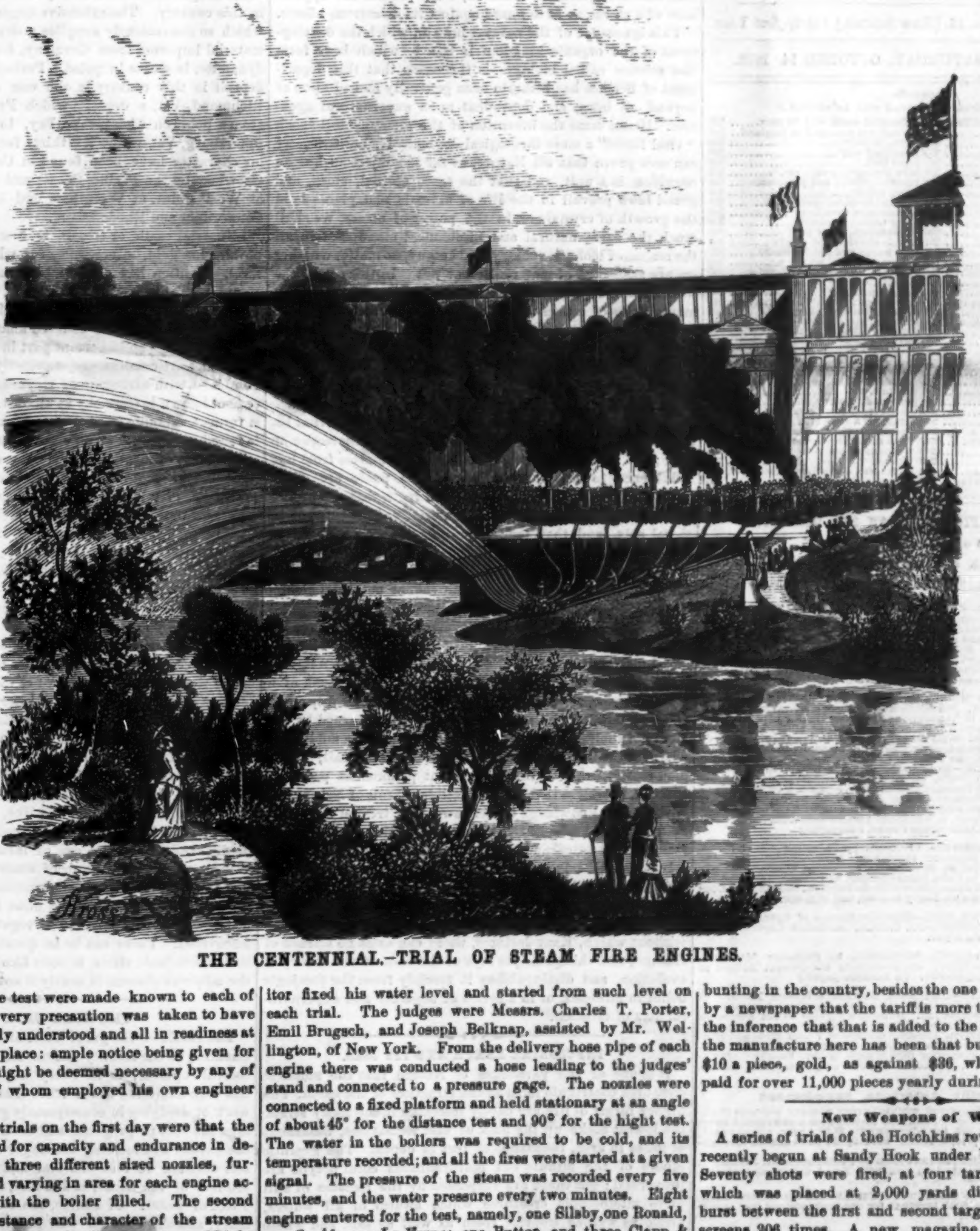
TRIAL OF STEAM FIRE ENGINES AT THE CENTENNIAL EXHIBITION.

There is probably no engine or machine in which the work done bears so great a ratio to the weight, strength, and size of the apparatus as the fire engine. The requirements of fire engines are so exacting, and the necessity for the greatest obtainable efficiency is so vitally important, that the cost is a secondary consideration. The breakage of a single bolt, pin, or casting may entail the loss of thousands of dollars' worth of property, in addition to the damage resulting to the engine; and hence it is that the material and workmanship employed in the construction must be, and are, of the very highest order. A steam fire engine is in actual use during but a comparatively short time of its period of existence, but it must always be ready to perform, at a moment's notice, its arduous and important duties; and the thorough order in which it must, therefore, be kept, makes it a fitting subject for beauty of design and ornamentation, so far as is consistent with the necessities of its construction. Thus it is that, for elegance and finish, the steam fire engine is unsurpassed in machine production.

The steam fire engines exhibited at the Centennial Exhibition are beautiful specimens of mechanical architecture, and form an attractive feature in Machinery Hall. Our illustration represents the trials of these engines, which were conducted by the judges on September 4, 5, 6, and 7. This exciting contest formed the center of attraction during those days, being attended by a large concourse of engineers and mechanics, as well as by the visiting public. The eagerness, watchfulness, and assiduity of the engineers, the restlessness of the contesting exhibitors, the gravity and coolness of the judges, the almost life-like struggle of the engines, together with the long rolling volumes of gyrating black smoke above, and the rushing stream of water beneath, formed a scene which made considerable impression upon contemplative minds.



THE CENTENNIAL.—TRIAL OF STEAM FIRE ENGINES.

The conditions of the test were made known to each of the contestants, and every precaution was taken to have every requirement clearly understood and all in readiness at the appointed time and place: ample notice being given for any preparations that might be deemed necessary by any of the contestants, each of whom employed his own engineer and assistants.

The conditions of the trials on the first day were that the engines were to be tested for capacity and endurance in delivering water through three different sized nozzles, furnished by the judges, and varying in area for each engine according to its weight with the boiler filled. The second day's trials were for distance and character of the stream thrown; and the third day's were for the character and hight of the stream. On each day, the trials were continued for three hours each. On the fourth day, the tests consisted of three runs over a course of a mile, each run followed by a play of about half an hour, in which nothing was used that was not carried over the course, the engineers and assistants making the trips with the engines. The engines were supplied with bituminous coal, the fuel used, both for lighting fires and and running, being weighed and charged to the account of each engine respectively. Each engine had connected to it 35 feet of suction and 100 feet of delivery hose, supplied by the exhibitors themselves, who had the liberty of selecting the size and kind of hose, and of using as many lines as they chose, provided that they joined into one before reaching the nozzle. The water was lifted 15 feet; and on the second and third days, the exhibitors selected their own nozzles, three of which were used, the sizes varying from the smallest to the largest used by them respectively on the first day's trials.

The engines were weighed previously to the trial, first without water and equipments, secondly with the boiler filled with water to its proper working level, and thirdly with equipments complete, ready for service. Each competitor fixed his water level and started from such level on each trial. The judges were Messrs. Charles T. Porter, Emil Brugsch, and Joseph Belknap, assisted by Mr. Wellington, of New York. From the delivery hose pipe of each engine there was conducted a hose leading to the judges' stand and connected to a pressure gage. The nozzles were connected to a fixed platform and held stationary at an angle of about 45° for the distance test and 90° for the hight test. The water in the boilers was required to be cold, and its temperature recorded; and all the fires were started at a given signal. The pressure of the steam was recorded every five minutes, and the water pressure every two minutes. Eight engines entered for the test, namely, one Silsby, one Ronald, one Gould, one *La France*, one Button, and three Clapp & Jones engines. The Button engine was disabled on the first day of the trial, in consequence of the fracture of a bracket attached to the cylinder head. The sizes of the nozzles used varied from about $\frac{3}{4}$ to $1\frac{1}{16}$ inches diameter of bore; the distance the water was thrown was about 220 feet. There are, we are informed, awards to be made to these makers independently of the data obtained from the trials, the results of which are not, as yet, fully computed by the judges. The merits or points of advantage in the respective engines are to be recognized by these immediate awards; and the results of the trial tests will be announced, and a suitable award made, at some future time. In the meantime, it is, we are informed, contemplated to secure the coöperative assistance of additional experts, in order to form a just and comprehensive decision as to the merits of the engines, as indicated by the data given by the logs of the whole series of tests.

American-made Bunting.

General Benjamin F. Butler gives the following account of the rise and progress of this industry:

"The manufacture of bunting was unknown in this country until after the close of the war, so that no American ship ever fought under a yard of American bunting. One or two attempts had been made to make it in America, which had failed. It was substantially a monopoly of a few firms in Bradford, England; and although it cost, in the war, the Englishmen to make it no more than now, they put up the price upon us to $36 gold per piece. In 1866, because I lived in a manufacturing city, I was requested by the Navy Department to examine into the subject and see if it could be made here. I consulted with some friends of mine in Lowell and interested them in the subject, and they agreed to make an attempt, provided I would furnish part of the capital, which I did. After many experiments, attended by very considerable expense, and by employing English machinery, an article of bunting was made, which, upon competitive trial with the English, was pronounced by a board of experts to be superior. The demand for the article is very limited, except in presidential years and the Centennial year. There are now three or four other establishments which manufacture bunting in the country, besides the one at Lowell. It is said by a newspaper that the tariff is more than the cost, leaving the inference that that is added to the price. The effect of the manufacture here has been that bunting is produced at $10 a piece, gold, as against $36, which our government paid for over 11,000 pieces yearly during the war."

New Weapons of War.

A series of trials of the Hotchkiss revolving cannon were recently begun at Sandy Hook under U. S. army auspices. Seventy shots were fired, at four targets, the nearest of which was placed at 2,000 yards distance. The shells burst between the first and second targets, hitting the four screens 206 times. A new magazine breech-loading rifle was also tested, and a firing speed of six shots in six seconds was attained. The cannon trials are soon to be resumed, when the capabilities of the gun will be put to the severest tests. The inventor, Mr. B. B. Hotchkiss, claims that the weapon has an effective range of 6,000 yards.

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WHAT IS MATERIALISM?

Those advanced scientists of the present day who have abandoned the old and easy way of explaining every obscure physical phenomenon by asserting a supernatural cause (such as vital force in the organic kingdom, or a separate creation for each species of plant or animal) are denominated "materialists" by the adherents of the supernatural or spiritual. Those who use this word so profusely confound, however, two very different things, which have nothing in common, namely, the scientific materialism and the immoral materialism. The scientific materialist maintains that all the phenomena we see on our earth take place by natural means, that every effect has its cause, and that every cause will produce its effect. In his view, law regulates the sum total of all physical phenomena, which depend on the necessary relations of cause and effect. He rejects, therefore, most emphatically, the belief in miraculous interferences, and every conception, of whatever form, based on a belief in the so-called supernatural. In his view, there do not exist, anywhere in the whole range of human cognition, real metaphysics, but everywhere only natural physics. For him, the inseparable connection of matter, form, and force is self-evident. This scientific materialism has long since been accepted in the realm of the inorganic natural sciences, physics, chemistry, mineralogy, geology; and no one, however poorly educated, has now the least doubt in regard to the correctness of basing these sciences on such materialism. Only savages believe now in the spirit of a cataract or of a storm, some supernatural power which presides over such phenomena; and this can arise but from utter ignorance of the whole system of natural laws, by which we are able to explain the existence of cataracts and storms: and not only this, but we can at present, thanks to our materialistic system of research, even predict the appearance of a storm, so as to guard against its disastrous effects.

This ignorance of the natural laws on which the development of the organic kingdom is based—which laws form the science called biology—is the cause that this department of Science has hitherto been generally looked upon as beyond all laws, and dependent upon supernatural agencies. Hence came the invention of the metaphysical spook "vital force," a mere theological dogma. If, however, we can now prove that all Nature, as far as subject to human cognition, is a unit, and that the same eternal, stern, and grand laws prevail in the life of animals and plants as in the growth of crystals or in the power of steam, we shall reach the same natural and mechanical standpoint in all the realms of biology, zoölogy, and botany, no matter whether we are suspected of materialism or not. In this sense, the whole realm of the positive natural sciences, and the fundamental laws of causes and effects, are pure "materialism."

A very different thing from this scientific materialism, however, is the immoral materialism, which, as we have stated, has nothing in common with the other, except its name. This materialism, in its influence on practical life, leads to nothing but material enjoyment and the indulgence of sensual passions. It lives under the sad illusion that indulgence to mere natural pleasures can give satisfaction to man; and under this illusion, it drives its votaries from one indulgence to another, while rest and peace are never reached. It is a grand and profound truth that the proper value of life does not reside in material enjoyment, but in moral acts, and that true happiness cannot be found in exterior appearance, but in virtuous conduct: this is, however, unknown to the votaries of the immoral materialism. For this reason, such a materialism cannot be found among the investigators of Nature; and philosophers, whose highest pleasure is the intellectual enjoyment of Nature, have for their highest aim the knowledge of Nature's laws. This immoral materialism was found especially among the religious pretenders of the middle ages, who, under the mask of a pious exterior, aimed at nothing but an hierarchical tyranny and a material exploitation of the possessions earned by the labors of their fellow men. Blind to the supreme nobility of what they called, and what their successors still call, "common matter," and to the magnificent phenomena produced thereby, as well as to the inexhaustible charms of Nature, and without any knowledge of her laws, they treated the whole field of natural science and all the civilization derived therefrom as an heretical and sinful materialism: while they themselves practised immoral materialism in its most abhorrent forms. To avoid confounding such immoral materialism with the scientific materialism, Haeckel proposes to call the latter "monism," or (with Kant) "the principle of mechanism," without which, Kant declares, there can exist no science of Nature; and this principle lays at the base of the theory of evolution, and distinguishes it forcibly from the theologic belief in miracles, or in a series of separate and supernatural acts of creation.

INFUSORIAL EARTH AND ITS USES.

It is one of the paradoxes of Nature that the smallest creatures contribute most to the structure of the earth. The higher forms of life are barely traceable in the rocky strata; the lowest make up the bulk of vast formations, thousands of miles in area, thousands of feet in depth. The gigantic labors of the minute but multitudinous coral polyps are proverbial: but these are surpassed by the remains of still more microscopic creatures which swarm in all waters, arctic as well as tropical, fresh as well as salt, and whose cast-off shells fall like a ceaseless rain of solid matter on every part of the ocean's bed, on the beds of every inland sea and lake, every river, and marsh, and roadside pool. And minute though they be, the bulk of matter they contribute to the earth's strata every year is quite incalculable. The celebrated microscopist Ehrenberg, the first to realize their importance, estimated that in the single harbor of Wismar, in the Baltic Sea, as much as eighteen thousand cubic feet of these silicious organisms accumulated annually. The deep sea explorers of the Challenger expedition found them everywhere above the depth of two thousand fathoms; and below that their insoluble remnants made up thousands of square units of "red clay" deposits, apparently the stuff from which the azoic bases of the continents were formed. The limestones and chalks derived from calcareous infusoria are still more abundant and important: and by no means insignificant are the unconsolidated silicious strata of modern origin, to which the name infusorial earth has been applied. The stratum at Bilin in Bohemia, in which Ehrenberg found the enormous number of forty thousand millions of individuals to the square inch, is eighteen feet thick, and extends over a large area. At Lünenberg is another deposit, nearly twenty-eight feet thick; and less important strata are found in other parts of Germany and throughout Europe. In Lapland and Sweden it constitutes the well known "mountain meal," used to swell the bulk of certain foods. Many deposits of considerable magnitude are known in England, and the Irish beds are celebrated, especially those of the county of Down. Africa for a long time monopolized the supply for use in the arts, and furnished the familiar name Tripoli. The material is now abundantly supplied by other parts of the African continent, by Asia, Australia, New Zealand, South America, our own country—indeed every part of the world. In South America, the natives count it in some parts an essential portion of their diet, using it as food mixed with fat. Along the Amazon, beds of this useful earth are numerous; and since the organisms which produce it are universally distributed, the deposits of it will doubtless be found more or less abundant everywhere when sought for. Such at any rate appears to be the case in this country. The extensive deposit at Drakeville, N. J., which so conveniently supplies a demand originally met by material imported from Germany, for the manufacture of dynamite, is a case in point. Perhaps the most extensive deposit in this country is the one underlying the city of Richmond, Va., a deposit which Professor Rogers traced from a point on Chesapeake Bay, in Maryland, to beyond Petersburg, Va., where it is thirty feet thick. Beds of similar character have been found in California, Oregon, and elsewhere on the Pacific Coast; and smaller deposits occur at West Point, at Wrentham and Andover, Mass., and in Connecticut and Rhode Island.

Infusorial earth, or tripoli, is best known as a polishing powder for gold, silver, etc., for which purpose it has no rival. Mention has already been made of its use in the manufacture of blasting powders, in which it serves the useful purpose of holding the explosive nitroglycerin. But these will ultimately be counted among the least of its uses. Already it plays an important part in the manufacture of cements and artificial stones, especially in Ransome's process. Combined with carbonate of magnesia, it forms the excellent cement known in Germany as albolite. With borate of lime, it forms a valuable glazing for furnaces, pottery, etc., and is found very useful as an enamel for iron and slate. Fused with borate of magnesia, it forms a beautiful and durable porcelain which can been cast and even blown like glass. A multitude of minor uses have been suggested, and many more will no doubt follow as our artisans become acquainted with its properties. Its lightness, indestructability by fire, and slowness of heat conduction are qualities of very great value. Bricks of it, with a little clay, are nearly as strong as common bricks, yet so light as to float on water. At the same time they are infusible, and such poor conductors of heat that they may be held at one end while the other is heated to redness. As an experiment, an Italian engineer constructed the powder magazine of a wooden vessel with such bricks, and when set on fire the vessel burned till she sank, without exploding the powder. The lightness of such fireproof bricks makes them specially valuable for such uses. They have also been used to advantage in the construction of reverberatory furnaces, pyrometers, etc. The heat-resisting quality of infusorial earth makes it not less useful as a protection to ice bins, ale cellars, etc., and as a lining for fireproof safes and the like, for which purposes it is rivaled only by asbestos. Agriculture furnishes another promising field for the use of infusorial earth. Professor Wilson, who has the honor of discovering the use made of this form of silica by plants, pronounces the application of it to fertilizing purposes the most important adaptation of matter for the reproduction of vegetation that has ever been discovered. There can be no question of the importance of such assimilable silica to soils like those of Bermuda, where the silicious element is nearly if not entirely wanting.

THE HELL GATE BLAST.

The result of the great blast at Hell Gate, or Newton's Channel, as the locality is now termed in honor of the successful engineer, is in every way satisfactory. The rock has been shattered much more than was expected, and the work of dredging is consequently greatly lessened. Soundings are still in progress, and divers are at work surveying the bottom and locating the larger fragments of rock. Vessels drawing 18 feet of water and over cannot pass within 300 feet of the shore; at 180 feet, there is a clear depth of 8 feet of water. Of course, the results are merely preliminary, and the channel will be gradually improved as the stone is removed. The pilots say that navigation is bettered already. In some localities eddies have been replaced by true tides, and the current has materially decreased in swiftness, while about 200 feet more room is afforded for passing the strait.

The observations of the shock wave generated by the ex

plosion were made by General Abbott and his assistants stationed at distant points, with whom telegraphic communication was held. At West Point, fifty miles away, no shock was perceptible even by the delicate instruments employed. At Springfield Junction, Long Island (not Massachusetts, as was at first reported) at a distance of twelve miles, the shock was noted in 13 seconds after the time of explosion. General Abbott is preparing a paper giving all the results of his observations, which will be read at the next session of the American Academy of Sciences.

Apart from the dredging, work at Hell Gate is by no means yet finished, and the operations are but fairly in progress on Flood Rock, the demolition of which is to leave a clear channel 1,200 feet in width. This rock forms a reef of about 7 acres in extent, and lies in the middle of the river, about 1,000 feet from Hallett's Point. Work was started on this obstruction in July, 1875, and continued steadily until May last, when the fear of its interference with the Hell Gate tunnels, through its growing proximity to them, together with the lack of necessary funds, determined its suspension. At the present time, two tunnels are partially finished. These are about 65 feet apart, aggregate in length 229 feet, and from them 1,462 yards of stone have been removed. Other tunnels have been begun. There is no coffer dam, as the point at which the main shaft is sunk is above high water mark. It is estimated that about two years of continuous labor will be required to complete the excavation, and that to blow it up 100,000 lbs. of explosive will be needed.

THE CENTENNIAL AWARDS.

The awards made to exhibitors at the Centennial Exposition were publicly announced on September 27. Some simple exercises, consisting of music and brief speech making, by Hon. D. J. Morrell, of the Centennial commission, Director General Goshorn, and others, took place in the Judges' Hall, after which General Hawley delivered the lists of successful competitors to the various national commissioners. General Hawley, in his remarks preceding the distribution, explained that the system which had been followed in granting these distinctions is different from any hitherto adopted at international expositions. The main features are the absence of any graded scale of merit and of distinctive prizes, the reduction in number of the judges, and the payment of the latter for their services. Medals of bronze are awarded, and each is accompanied by a brief report stating why the exhibit is deemed worthy of distinction. This report is of more intrinsic value to the exhibitor, as indicating the relative merits of his exhibits over others, than the possession of the medal. A copy of the report signed by a judge who is individually responsible for the opinions set forth (which views are further attested by the signatures of as many of the examining group as concur therein) is furnished to the exhibitor with authority to reproduce it in any way deemed, most to his advantage. It will be observed that the written professional opinion of a paid expert is here substituted for the anonymous verdict of a jury; and therefore in that opinion, and not in the mere bestowal of a medal, the value of the award lies. Of course under this plan several awards may be given in the same class of articles, based upon the same or differing qualities.

The American awards number several thousand, and the mere list occupies twenty-eight closely printed columns of the New York *Times*. It is manifestly impossible, therefore, for us to publish all of them. We note, however, a few of the firms best known to our readers, upon whom well merited honors have been bestowed: In the mining and metallurgy group, the Blake Crusher Company, for their ore and stone breaker; P. H. & F. M. Roots, for pressure blower; B. F. Sturtevant, for fan blower; the Loiseau Pressed Fuel Company, for artificial fuel; Jones & Laughlin, for cold rolled shafting; in the cotton and linen fabric group, Messrs. J. & W. Lyall, for the positive motion loom, which we recently described; and the same firm obtain another award for a sewing machine, which presents some points of remarkable ingenuity which are not generally known. It is a double thread lock stitch shuttle apparatus, capable, when driven by steam power, of making 2,500 stitches per minute, something, we believe, hitherto unparalleled in machines of its class. Mr. James Short is awarded a medal for his carpet loom; the Dixon Crucible Company, one for lead pencils. Among the printing presses, the Campbell and Cottrell & Babcock are both distinguished. Among the pumps, those of the Valley Machine Company, the Gould Manufacturing Company, L. J. Knowles, the Silsby Manufacturing Company, Bagley & Sewall, and the Niagara Works gain medals. Other successful competitors in the machinery groups are Nathan & Dreyfus, lubricators; Chalmers Spence Company, boiler and pipe covering; Branch, Crookes & Company, stone saw, countershaft, belt tightener, etc.; John A. Roebling's Sons & Company, wire rope; John T. Noye & Son, turbine wheel; Frick & Company, engines; Utica Steam Gage Company, gages; Babcock Manufacturing Company, fire extinguishers; Bolen, Crane & Company, hydraulic press; Ward B. Snyder, small steam engines; Buckeye Engine Company, engines; Lidgerwood Manufacturing Company, rotary engines; Stillman B. Allen, governor; I. B. Davis, Berryman feed water heater and purifier; Morris, Tasker & Company, wrought iron tubes, Burleigh Rock Drill Company, air compressors; Stillwell & Bierce Company, turbine wheel, feed water heater, etc.; Jerome Wheelock, piston packing; Hugh Young, stone saw; Emerson Steam Stone Saw Company, same; Union Stone Company, emery wheels; C. & S. Burt, shingle machine; J. A. Fay & Company, woodworking machinery; E. & B. Holmes, barrel machinery; H. B. Smith, woodworking machinery; Stiles & Parker, drop presses, etc.; Fitchburg Machine Company, machine tools; Trump Brothers, scroll saw; Campbell & Clute, knitting machines; Hull & Belden Company, drop forges, etc.; R. S. Newbold & Son, shearing machine; Richards, London & Kelley, woodworking machinery; Bentel, Margedant & Company, same; Pratt & Whitney Company, metal working tools; Brown & Sharpe Company, same.

The completion of the awards at this early day is a substantial triumph for the new jury system. The whole board of judges numbered but 250, and they were called upon to examine the contributions of over 30,000 exhibitors. When it is remembered that, at the American Institute and local fairs in general, the judges' reports are rarely finished till after the close of the exhibition, to the dissatisfaction of exhibitors, the advantage of employing paid experts is manifest. The judges at the Centennial were allowed compensation, obviously small in comparison with the duties imposed; but it was sufficient to fulfil its purpose and render the judicial labors a business transaction instead of one resting on mere favor and obligation. We commend the result to the notice of present and future fair managers. Exhibitors go to considerable expense to attend local fairs, in hopes of obtaining valuable reports on their productions, and it is but right that they should have them before the fair closes. At the Centennial it has been proved that this can be satisfactorily accomplished.

A CIGAR SCIENTIFICALLY DISSECTED.

A polite visitor, who, during his interview with us, had rendered our sanctum redolent with the fumes of a fragrant Havana, has just left a cigar on our table with the laughing request that we smoke it. Despite the fact that it is an exceptionally fine cigar, we are unable to gratify our friend's desire, seeing that we don't smoke; but the thought occurs that we can show our appreciation of the gift by applying the light, not of a match but of science, to it, and thus giving our friend and his brother smokers something to ponder over next time "the blue up-curling smoke" leads them to reverie.

To the world in general a cigar is merely a tightly rolled packet having brittle fragments of dry leaves within, and a smooth silky leaf for its outer wrapper. When it is burnt, and the pleasantly flavored smoke inhaled, the habitual smoker claims for it a soothing luxury that quiets the irritable, nervous organism, relieves weariness, and entices repose. Science, scouting so superficial a description, examines first the smoke, second the leaf, third the ash. In the smoke is discovered water in vaporous state, soot (free carbon), carbonic acid and carbonic oxide, and a vaporous substance condensable into oily nicotine. These are the general divisions, which Vohl and Eulenberg have still further split up; and in so doing have found acetic, formic, butyric, valeric, and propionic acids, prussic acid, creosote, and carbolic acid, ammonia, sulphuretted hydrogen, pyridine, viridine, picoline, lutidine, collodine, parvoline, coridine, and rubidene. These last are a series of oily bases belonging to the homologues of aniline, first discovered in coal tar. Applying chemical tests to the leaves, other chemists have found nicotia, tobacco camphor or nicotianine (about which not much is known), a bitter extractive matter, gum, chlorophyll, malate of lime, sundry albuminoids, malic acid, woody fiber, and various salts. The feathery white ash, which in its cohesion and whiteness is indicative of the good cigar, yields potash, soda, magnesia, lime, phosphoric acid, sulphuric acid, silica, and chlorine. Our friend has kindly left us a fine cigar; had it been a poor and cheap one, the ingredients we should extract would be fearful and wonderful to contemplate. Here is the list from an English parliamentary report on adulterations in tobacco. Sugar, alum, lime, flour or meal, rhubarb leaves, saltpeter, fuller's earth, starch, malt commings, chromate of lead, peat moss, molasses, burdock leaves, common salt, endive leaves, lampblack, gum, red dye, a black dye composed of vegetable red, iron, and liquorice, scraps of newspaper, cinnamon stick, cabbage leaves, and straw brown paper.

Returning now to the smoke, or rather its ingredients, Dr. B. W. Richardson, in his "Diseases of Modern Life," considers the effect of the same on the body at considerable length, basing his conclusions on actual investigation. He tells us that water, of course, is harmless; free carbon acts mechanically as an irritant, and tends to discolor the secretions and the teeth. Ammonia bites the tongue, exercises a solvent influence on the blood, excites the salivary glands, and thus causes a desire to drink while smoking. The tendency of carbonic acid is to produce sleepiness, headache, and lassitude. When a cigar is smoked badly, that is, when the combustion of the tobacco is slow and incomplete, carbonic oxide is produced in small quantities, and is an active poisoning agent, resulting in irregular motion of the heart, vomiting, convulsions of the muscles, and drowsiness. The nicotine tends to cause tremor, palpitation of the heart, and paralysis. The volatile empyreumatic substance produces a sense of oppression and taints the breath and surroundings of the smoker with the well known "stale tobacco smoke" smell. The bitter extract causes that sharp nauseous taste peculiar to a re-lighted cigar or an old pipe.

By trying the effect of tobacco smoke on lower animals, we can obtain an idea of its influence on ourselves. Small insects are stupefied rapidly, but recover in fresh air. Cold-blooded animals succumb slowly to the smoke, birds rapidly. Some animals, such as the goat, can eat tobacco with impunity; but none escape the effects of the fumes. Persons suffer most from tobacco while learning to smoke. Dr. Richardson says that the spasmodic seizures are sometimes terrible, especially in boys. There is a sensation of imminent death, the heart nearly ceases to beat, and sharp pains shoot through the chest. Examination of inferior animals under such conditions shows that "the brain is pale and empty of blood; the stomach reddened in round spots, so raised and pile-like that they resemble patches of Utrecht velvet." The blood is preternaturally fluid, the lungs are as pale as those of a dead calf, and the heart is feebly trembling: such is the primary action of one's first cigar.

After a time, however, the body becomes accustomed to the influences of the poison; and with the exception of constant functional disturbances (owing to the excretory organs, notably the kidneys, being compelled to do work not essential to their duties), no distressing results are felt. There are numerous instances where the evil effects are scarcely appreciable, the physical and nervous constitution of the smoker being capable of resisting the influence. In many cases copious salivation attends smoking, and in this circumstance the opponents of tobacco have found a strong argument. Still, either to expectorate or not to do so is a choice of two evils. In the latter case, the result is to swallow the saliva charged with poisonous matter; in the former, the saliva needed to prepare food for digestion is lost, and besides, as it contains salts of lime in solution, the effect is to produce large formations of tartar on the teeth. "Smoker's sore throat" is a special irritable state of the mucous membrane induced by cigar smoking, which soon disappears when the habit is broken off. Tobacco smoke does not produce consumption or bronchitis, but it tends to aggravate both maladies. Its effect on the organs of sense is to cause, in the extreme degree, dilation of the pupils of the eye, confusion of vision, bright lines, luminous or cobweb specks, and long retention of images on the retina, with other and analogous symptoms affecting the ear, namely, inability to define sounds clearly and the occurrence of a sharp ringing sound like that of a whistle or a bell. Its effect on the brain is to impair the activity of that organ and to oppress it if it be duly nourished, but to soothe it if it be exhausted. It leads to paralysis in the volitional and in the sympathetic or organic nerves, and to over-secretion from the glandular structures. Science was not wise enough to prepare so formidable an indictment of the nicotian weed as the above in King James' time, else that monarch might have had better ground than his personal dislike for stigmatizing the habit of smoking as a "custom loathsome to the eye, hateful to the nose, harmfull to the braine, dangerous to the lungs, and in the black stinking fume thereof, neerest resembling the horrible Stigian smoake of the pit that is bottomlesse."

And yet, despite all that Science can say, the habit is increasing. Two centuries ago the Turks regarded smoking as a religious offense, and paraded a smoker through the streets of Constantinople with his pipe stuck through his nose as a warning to others. Who can disconnect the Turk now from the ideas of chibouque or nargileh, or fragrant Latakia? Look at the best cigar wrappers the world can produce, raised on tobacco fields in the heart of New England, where the Puritan fathers once visited the direst of blue law vengeance on the wretch who profaned His Maker's handiwork by "making a chimney of his nostrills." The value of our tobacco crop last year reached nearly $30,000,000. We consume annually some 75,000 hogsheads of the leaf; we imported about 83,000 bales of cigars, etc., from Cuba in 1875.

What is the end of it all? Effects on individuals likewise affect communities, these in turn influence the nation. No person that smokes can be in perfect health, and an imperfect organism cannot reproduce a perfect one. Therefore it is logical to conclude that, were smoking the practice of every individual of a nation, then that people would degenerate into a physically inferior race. It would follow, moreover, that, in those countries where smoking is most practised, a lower physical, and a consequently lower intellectual, development must be found. Such, we think, will be conceded to be true of Spain, of Cuba, of Portugal, of Turkey, of Greece, and of the South American countries, where those who are addicted to the habit vastly outnumber those who do not smoke.

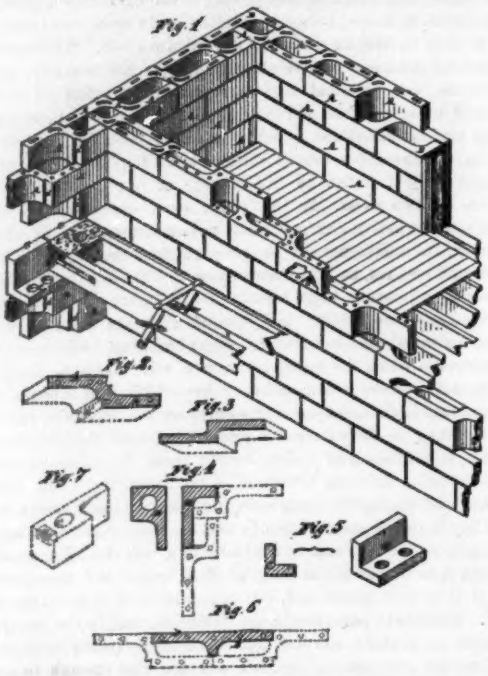
Passage of Electricity through Gases.

The author inserted in the circuit of an induction current a variable spark interval, a strong resistance in form of a tube with blue vitriol solution, which could be shortened or lengthened, and a galvanometer; and observed each time how much the liquid resistance had to be changed, in order, after determinate change of the spark interval, to obtain the same deflection of the galvanometer. The spark path was inclosed in a glass sphere in which the gas and the pressure could be varied. The conclusions arrived at are stated briefly thus:

1. Gases conduct electricity, in the glowing state, like metallic conductors. The induction spark is a suitable means for the comparative experiments. 2. The conductivities of gases at ordinary pressure are not inconsiderably different from each other. Perhaps this difference may be attributed to differences of temperature of the spark interval in the separate gases. 3. With decreasing pressure, the conductivity of gases increases very considerably. At small pressure, the gases differ very little from each other. 4. With less strength of the current, there is a decrease of the conductivity, probably due to the less temperature of the gas. 5. The conductivities of gases for electricity and heat stand in no close relation to each other. 6. The values found for the specific resistances investigated are to be distinguished from the resistances at the beginning of the discharge, which have before been investigated by other physicists.—*M. Oberbeck.*

IMPROVED BUILDING BLOCKS.

Mr. Nicholas J. Clayton, of Galveston, Texas, has recently (August 15) patented a cellular building block, of which we give engravings herewith. Fig. 1 is a perspective view of a portion of a building in process of erection. Fig. 2 shows one of the main building blocks, and Fig. 3 one of the partition wall blocks. In Fig. 4 are seen two forms of angle blocks or quoins. Fig. 5 gives two views of the bearing blocks for the joists. Fig. 6 shows a flue block, and Fig. 7 a jamb block. The blocks may be made of artificial



stone, cement, or clay, baked afterwards; and they are so constructed as to tie the outer and inner parts of the hollow wall securely together, forming one wall with numerous cells or passages through it.

A are the building blocks for the main walls, which are made with offsets in their middle parts, binding the two walls together. The offsets of the blocks, A, have rabbets, a', formed in them to form seats for the ends of the adjacent blocks. B B are corner blocks, which may be formed of two wings meeting each other at right angles, the shorter wing being of a length equal to the thickness of the wall; or the outer end of the block, B, may be made solid for a distance equal to the thickness of the wall, and with a hole through said solid part. C are right-angled blocks, the outer end of which is vertical, and forms a part of the outer walls. The inner wing of the blocks, C, is horizontal, and forms a support or rest for the ends of the joists. Through the horizontal parts of the blocks, C, between the places where the ends of the joists will rest, are formed holes to connect with the cavities above and below said blocks. The space above the horizontal wing of the block, C, and between the ends of the joists, may be filled with concrete or with blocks of the proper size, to support the blocks, A, placed above them. The blocks, D, are for forming chimney and ventilating flues; and they are made with a projection or flange upon the middle part of their inner sides of such a hight as to meet the inner ends of two adjacent blocks. In places where woodwork is to be attached to the wall, recesses are formed in the blocks to receive pieces of wood to which said woodwork may be nailed. In the upper and lower edges or sides of the blocks, A are formed holes or recesses of any desired shape for the cement or mortar, with which said blocks are laid, to enter, and thus key or dowel the said blocks together.

He Wanted to Sell a Patent Machine.

Soon after dinner yesterday a pleasant-faced man, having something wrapped up in a paper under his arm, called at a Detroit hotel, and requested a few minutes' conversation with the landlord. When they were seated, the stranger began: "I am an old landlord myself. I kept hotel in St. Louis for twenty eight years."

"Yes," was the non-committal reply of the landlord.

"And of course I know all about the inconveniences of hotel keeping," responded the man. "There were bugs around the beds in my hotel, and there are bugs around the beds in any hotel, I suppose. Of course I used to lie to the guests, but the bugs were there, and I knew it."

"What do you mean?" demanded the landlord, growing red clear round to his neck.

"Just keep right still," replied the man, "for now I'm coming down to biz. This is the summer season, isn't it, and the only season when bugs bite? In the winter they are dormant, and unless there's a fire in the room they don't care to get in their work on the weary traveler. Well, the summer season is the season for the mosquito also. All hotels and houses have mosquitos, and nothing is thought of it. They seem to be a sort of necessity. Travelers will raise a howl over bugs, but they never grumble at anyone about mosquitos."

"Sir! do you think I keep a junk shop?" roared the landlord.

"No, sir; I don't. This is a regular hotel, and a very good one. As I was going to remark, I have invented and patented a machine, operated by a boy and a crank, which you and all other landlords want and will have. It is a machine to imitate the hum of the mosquitos. Its notes can be heard all over each floor, and with a good boy at the crank there can be no failure. The traveler, just dozing off to sleep, hears the hum. At the same time a bug works out from under cover. Then more hums and more bugs. Actually, sir, without any lying or exaggerating, men will strike and claw the air all night long to kill imaginary mosquitos, while the bugs go unmolested and grow fat. The hum is a perfect imitation, and has even deceived Yale College professors. Without it your guests will blow around about bugs. With it no traveler will mention bugs at all, but will rip and tear at the mosquitos."

"Do you mean to insult me?" shouted the landlord.

"No, sir."

"But you talk as if I had bugs in my house!"

"I tell you what I'll do, landlord. I'll examine five beds, and if I do not find bugs in at least three of them I'll give you a machine for nothing."

It would have been a nip and tuck fight if the great big porter hadn't jumped in and hit the stranger with an iron boot jack. The inventor still lived, however, and within an hour was seen bearing down for another hotel under full sail.—*Detroit Free Press.*

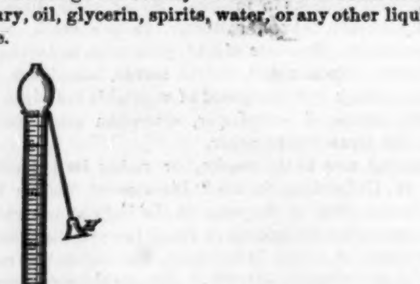
Knight's New Mechanical Dictionary.

Mr. Edward H. Knight, the author of the "New Mechanical Dictionary," now in process of publication by Messrs. Hurd & Houghton of the Riverside Press, Boston, informs us that the last sheets of the manuscript of his work have just been placed in the printer's hands. The fact is an event in the annals of literature in this country, as it marks the substantial completion of a great and elaborate undertaking, the labor on which has extended over a period of eight years. It is difficult to realize how colossal is the task involved in the preparation of a work of this description. Thousands of patents, American and foreign, have been digested, industrial processes of every nature have been examined, and the latest improvements therein noted. Engineering works, scientific discoveries, and tools of every craft have been studied; and finally all this immense collection, gathered from the whole field of applied science, has been subjected to careful revision and condensation, and, by means of ingeniously contrived systems of indexing, rendered invaluable for purposes of reference and research. Add to this the labors of artist and engraver, and there is little food for marvel that the work has cost $100,000; that it treats of 20,000 subjects; contains 7,200 engravings; and that its three volumes include 2,800 pages. It is more an encyclopædia than a dictionary; it is in fact a mechanical and scientific library, carried up to the latest dates.

The many extracts froms its pages which we have published will serve to give our readers an idea of its range of subjects. No single topic, however, has been wholly reproduced in these columns, as the engravings have been selected for their individual interest from the mass of the work, and afterwards grouped as seemed to us best befitting their character, without any reference to the author's classification. A just estimate of the comprehensive nature of the work, and its importance to inventors, engineers, and artisans of every class and in all libraries, can only be gained by careful examination of the volumes themselves. The work is published in parts, forty of which have appeared; and the remaining ones will shortly follow.

A POCKET LUNG TESTER.

Mr. William H. Burt, of Chicago, Ill., has patented through the Scientific American Patent Agency, August 8, 1876, a new spirometer, by which the breathing capacity of a person's lungs can readily be measured in cubic inches, by mercury, oil, glycerin, spirits, water, or any other liquid substance.



A is a glass bulb for containing the mercury or other liquid substance. B is the rubber tube, with a mouthpiece, C; and D is the scaled tube for measuring the hight of the column raised by the lungs. The rubber tube connects with a nozzle on the top of the bulb, and the glass tube connects with the bottom of the bulb by a return bend. The top of the vertical tube is open to the atmosphere, to prevent compressing the air above the liquid; and a little cap, E, may be used for closing it, to exclude dust, etc., and to prevent the liquid from running out by pneumatic pressure. This cap must be taken off when in use. It is only necessary to blow into the mouthpiece, when the hight of the mercury represents the lung pressure exerted.

A LIFE-PRESERVING CAP AND CAPE.

Messrs. E. J. McCarthy, of Red Hook, N. Y., and Gaston Wilbur, of Saugerties, N. Y., have recently invented a new sleeping cap, the object being to furnish a cap which may answer the threefold purpose of protecting the wearer from cold and storm, of an air pillow, to be used on the cars or in camp, and as a life preserver. The cap is made from rubber or other material which is impervious to water or air, and is provided with an external envelope, *a*, which is also made from waterproof material, and is united to the band of the cap by an airtight seam. A tube, *b*, having a suitable mouthpiece and valve, is attached to the cap, for inflating it while it is on the head. A cape, B, is attached to the cap, and is made from waterproof material, and is double at *c*, so that it may be inflated by blowing through the tube, *d*, which is provided with a mouthpiece and valve.

It will be seen that, when the cap and cape are not inflated, it forms an ordinary storm cap, and that when it is inflated the confined air in the space serves to protect the head from cold and to afford the necessary buoyancy for a life-preserver. This device was patented through the Scientific American Patent Agency, August 8, 1876.

An African International Exposition.

Expositions seem to be becoming epidemic. There is our own Centennial, named first because actually the largest yet held, but to be eclipsed, it is said, by the grand French show of 1878. An exposition of marine and life-saving devices has lately been in Brussels, Belgium; another of general exhibits, of which we have heard little save the fact of its existence, has been held in Finland. There are rumors of a grand international display in Australia, soon to occur; and now last of all, South Africa announces that a World's Fair is to open in Capetown, Cape of Good Hope, on February 15. The director general of the African Exposition is already *en route* for Europe and this country: and before very long, our manufacturers will be informed that industries at the Cape are at the lowest ebb, that an exhibition of what other people in the world are doing is needed to wake up the colonists, and that probably any portions of our splendid exhibit in Philadelphia will be gladly made part of the African show. We advise exhibitors to keep all their decorations, show cases, special machines, and extra fine goods, prepared for the Centennial, in as good order as possible, and not to think of throwing the two first named articles aside when the Exposition is over, as there are plenty of opportunities to come, when all such will be found abundantly useful.

The Effects of Physical Culture.

An official inquiry into the results of gymnastic exercises has recently been instituted at a military gymnastic school in France. The results of the inquiry, which extended over six months, established: 1. That the muscular force is increased, on an average, 15 to 17 per cent, and occasionally from 25 to 30 per cent, while the force has, as we might expect, a tendency to become equal on both sides of the body. 2. That the capacity of the chest is increased by one sixth at the lowest. 3. That the weight of the individual is increased from 6 to 7 per cent, and occasionally from 10 to 15 per cent, while the bulk of the body is diminished, thus showing that profit is confined to the muscular system. The increase of muscular force was generally confined to the first three months of the course. During the last moiety a serious diminution usually occurred; and here the dynamometer gave positive indication of the necessity of moderating or suspending the exercises.

Dangers of the Sea.

The steamer Arbitrator left New Orleans, August 9 last, for Liverpool. On August 23, when about 100 miles east of Halifax, N. S., she struck a ledge of floating ice, and ran right upon it as far as the foremast. She then made water rapidly, and went down stern foremost, the ice holding her up forward. After being in the boats several hours, the crew were picked up by the brigantine Baltic, and landed at Dublin.

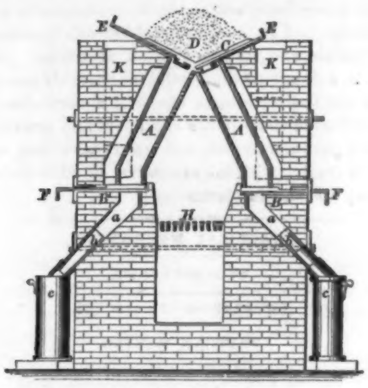
APPARATUS USED IN INDUSTRIAL PROCESSES.

Our extracts this week from Knight's "New Mechanical Dictionary"* include apparatus of various kinds employed in several industrial processes. Fig. 1 is a

BONE BLACK FURNACE,

used for revivifying bone black for the purification and decolorization of saccharine solutions. The bone black, D,

Fig. 1.



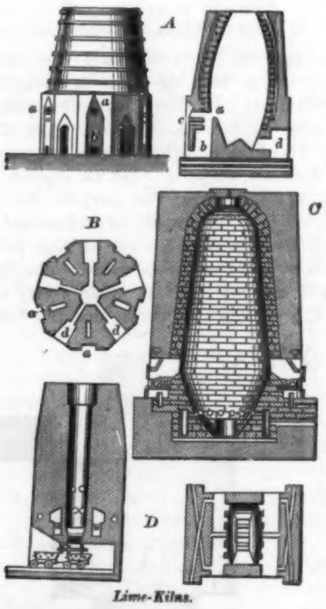
Bone-Black Furnace.

charged with impurities, is deposited in the hopper, C, where the withdrawal of slides, E, permits it to fall into the tubes, A, which are exposed to the heat from the grate, H, until the impurities are discharged. Then, by withdrawing the slides, F, on the bottom plates, B, it passes into the tubes, *a b*, and is received in vessels, *c*. At K are flues for conducting off the products of combustion and partially drying the black before it is admitted to the tubes, A. The process of

LIME BURNING

consists in calcining the carbonate in the form of limestone in kilns, during which the carbonic acid is driven off, leaving oxide of calcium or quicklime. Fig. 2 represents various forms of kilns. A B represents the kiln used at Ruders dorf, Prussia, and adapted to burn one part wood to four of turf. It has five fireplaces, *a*; *b* is the ash pit; *c c* are openings for regulating the draft, and at *d* are apertures for withdrawing the lime. The kiln is lined with a double thickness of fire bricks, the space between which and the outer masonry is filled in with well rammed cinders to prevent loss of heat. In the kiln, C, blasts of air are forced through the burnt and cooling lime, and mingle with the

Fig. 2.



Lime-Kilns.

hot currents from the furnaces. The latter are placed around the kiln, and air blasts are driven through the fuel. The upper end of the kiln is arched over, and the feed hole has a removable cover. The kiln, D, has bottom discharge, and the furnaces arranged on each side connect with it. A cross arrangement of flues counteracts irregularities of draft on the windward and leeward sides. Fig. 3 is a form of

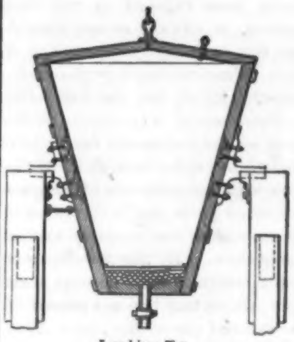
LEACHING VAT,

used in the process of chlorinating gold It is made of two inch plank, and is pitched inside. Lead discharge cocks are placed at the bottom; and under the false bottom, which is fastened so that it will remain in place when the vat is overturned, pieces of quartz are loosely laid. A pipe inserted into the airtight lids leads the chlorine gas from one vat to another of a series. The vat, before the admission of gas, is charged with the auriferous material. After the gold is dissolved, water is admitted, carrying off the chloride of gold to a vat, When the ore is thoroughly leached, it is discharged into a car and removed outside the works. Another process for the extraction of gold or silver from comminuted ore is conducted by exposing the material to molten lead, with which it forms an alloy. The apparatus is

THE LEAD BATH.

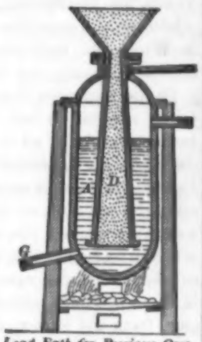
In the form represented in Fig. 4, the ore occupying the

Fig. 3.



Leaching-Vat.

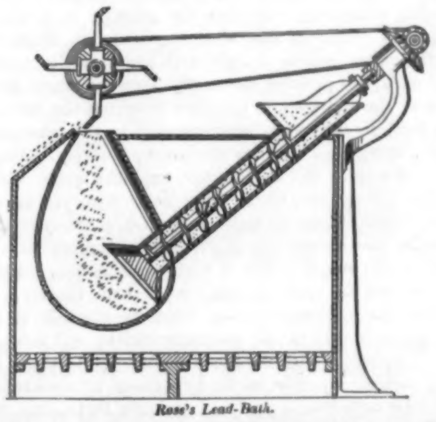
Fig. 4.



Lead-Bath for Precious Ores.

central shaft, D, is discharged beneath the column of lead, A, which is kept molten by the furnace beneath. The heavier portions of the alloy are drawn off by the pipe, G. The ore rises through the lead, bringing the particles of precious metal in contact therewith. The flow of ore is assisted by withdrawing air from above by an air pump. In Rose's lead bath, Fig. 5, the vessel is suspended in a furnace,

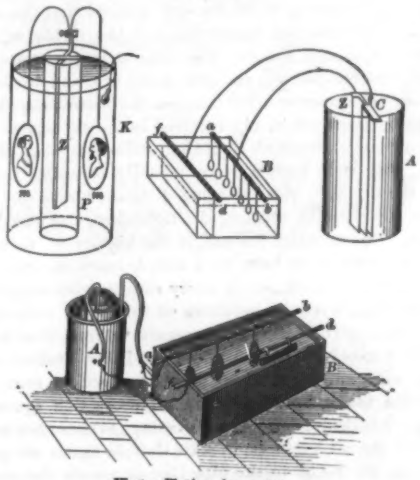
Fig 5.



Rose's Lead-Bath.

through which extends an inclined tube which discharges its contents near the bottom. The tube has a propelling screw, with a shoulder and elastic collar at its bearing, and a grinding plate at its lower end, which works against a grinding surface. Above the mouth of the vessel is a wheel which removes the waste ore as it rises to the surface of the

Fig. 6.



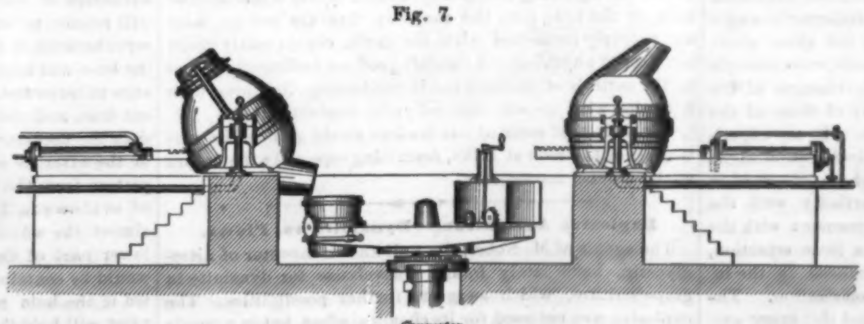
Electro-Plating Apparatus.

molten lead. Fig. 6 represents the apparatus commonly employed in

ELECTROPLATING.

A is the battery, and B the vessel into which the solution of the metal to be deposited is placed. The molds are suspended from a metallic rod, *a b*, opposite to which the plate,

Fig. 7.



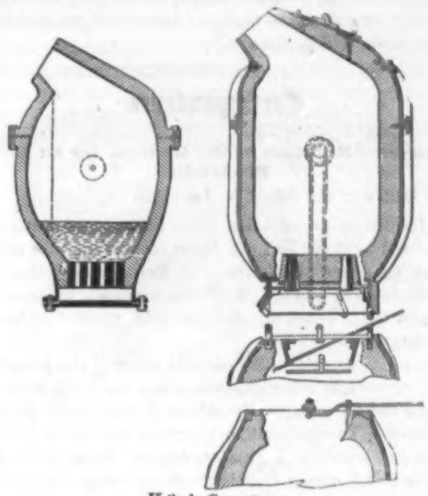
Converter.

f d, is hung. Copper. if the solution be of a salt of that metal, serves as a soluble electrode, and is dissolved in the same ratio as the metal is deposited upon the mold. The battery being charged, *f d* is put in communication with the copper pole, C, by a copper wire, and *a b* is connected with the zinc pole, Z. The current produces decomposition, and the electro-positive metal is deposited on the object attached to the negative pole.

THE CONVERTERS

used in steel making are represented in Figs. 7 and 8. The

Fig. 8.



Holley's Converter.

five-tun converter is an iron vessel, 14½ feet high and 9 feet in diameter externally, of a bulbous shape, and hung upon trunnions. The lower hemisphere is truncated, giving a flat bottom, five or six feet in diameter. The upper hemisphere terminates in a large neck inclined sidewise, so that a flame issuing under pressure from the mouth of the upright converter is obliquely directed into a chimney, guarded by a hood. The whole vessel has a rude resemblance to a pear. It is supported by heavy trunnions on each side of the center, and revolved upon these by hydraulic power.

This huge iron bottle, with its neck awry, is lined with a foot of refractory material, known as ganister, to preserve the iron shell. The trunnion is hollow, and a passage from it runs down the outside, looking like a strong rib in the iron surface, to the bottom, where it communicates with the tweers. The bottom of the Holley converter is movable, and when taken out looks like a great plug of fire brick, two feet high, resting upon a cast iron disk. The tweers, or nozzles for the blast, are imbedded vertically in the lining, and present ten groups, each containing a dozen three-eighth inch holes. The aggregate area of these openings is equal to that of a single tweer 4·1 inches in diameter; but the thorough agitation produced by dividing the blast secures much greater useful effect. The pressure of the blast is twenty-five pounds per square inch.

The converter in its upright position, being heated by a charge of coals and the blast, is turned mouth downward to vomit out the glowing coals, then upon its side to receive its charge, which runs from the cupola furnace above, along a trough, and plunges into the mouth of the converter. The position of the retort as this time prevents the charge from running into the tweers before the blast begins. Afterwards the pressure of the air itself keeps the passages clear. Then the blast is let on, and the converter swung back to a vertical position. A tongue of white flame comes roaring out of the mouth. The silicon of the pig oxidizes first, without very intense flame; but as the graphite and especially the combined carbon begin to burn also, the heat rises to some 5,000° Fah., and the light is so brilliant as to cast shadows across full sunshine

In fifteen or twenty minutes the marvelous illumination ceases more suddenly than it began. The volume and brilliancy of the flames diminish together with startling rapidity. This change of the Bessemer flame marks the elimination of most of the carbon, and indicates the critical moment. When it arrives, the blast is stopped, the converter is turned upon its side, and 600 pounds of melted spiegeleisen are turned into it, as the pig was previously charged. The reaction is instant and violent. The manganese of the spiegeleisen combines with any sulphur that may remain in the bath, forming compounds which pass into the slag. It also decomposes, in the slag, silicates of iron, taking the place of the iron and returning it to the bath. Finally, the carbon and manganese together reduce the oxide of iron formed during blowing, which would destroy the malleability of the iron. This is quickly accomplished, and now the gigantic converter, like a monster weary of drinking boiling iron and snorting fire, turns its mouth downward, and discharges its contents into a vast kettle or ladle, brought underneath for the purpose by one of those intelligent cranes that stand around, so silent and so helpful. The ladle is swung over the molds ranged round the side of the semicircular pit below, like a row of Ali Baba's oil jars, each capable of containing a bandit. The white, one would almost say transparent, metal is drawn off into these through a tap hole in the bottom of the ladle, retaining the slag which floats on the surface till the last. When the first mold is filled, the plug is closed, the ladle swung round to the second mold, and so on till all the steel is thus cast into ingots, the size of which varies with the kind of work for which the steel is required. A thin

*Published in numbers, by Messrs. Hurd & Houghton, New York city.

steel plate is placed on the top of each casting immediately the mold is filled, and over this a bed of sand is placed, and speedily and firmly pressed down.

As soon as the ingots have solidified, and while they are still glowing, the molds are lifted off them by means of an hydraulic crane, and afterwards the ingots are picked up by tongs attached to the same machinery, and are carted away, all red hot, to the hammer shops, where they are thumped and rolled or otherwise tortured into their required forms of rails, tires, and plates.

Correspondence.

The Inverse Rotation of the Radiometer an Effect of Electricity.

To the Editor of the Scientific American:

In a former communication to the SCIENTIFIC AMERICAN, I endeavored to show that the direct rotation of the radiometer was an effect of electricity. Before attempting to explain the inverse rotation, it will be necessary to state briefly some new facts which my electroscopic researches have led me to establish.

In order to ascertain the electric state of their inner surfaces, I exposed, to solar radiation, glass receivers such as are used for the air pump. By means of the proof plane and electroscope, I found that this surface was electrified negatively, and even to a greater degree than the exterior. This excess of energy I attribute to the numerous reflections from the interior. If, however, we hold one of these electrified receivers near the Böhnenberger electroscope, taking care that it does not come in contact with it, the electroscope at once indicates the presence of positive electricity. As both the outer and inner surfaces are negatively electrified, this phenomenon must be attributed to the electricity developed in the interior of the glass itself by its molecular polarization and feeble conductivity. The following experiment confirms this explanation If we remove from the exterior, by means of the proof plane, a portion of the negative electricity, and then approach, as before, the globe to the electroscope, a remarkable increase of positive electricity is at once shown. The same results are observed in the radiometer.

I next examined the electric state of the exterior of the radiometer globe when placed in partial obscurity and moistened with ether. There are no signs whatever of electricity, as long as the inverse rotation continues; but as soon as the direct rotation commences—on account of the obscure radiations given forth by the surrounding bodies—positive electricity manifests itself and rapidly increases. While in this state, I exposed the radiometer to solar radiation, and I found that this positive electricity remains quite a long time, and that, notwithstanding the positive charge on the exterior, the direct rotation continues with its usual rapidity.

The fact last mentioned enabled me to determine by experiment the electric state of the inner surface of the radiometer globe. Only two suppositions can be made in regard to it: either the electric state of the inner surface is dependent, by means of molecular polarization, upon the electric state of the exterior, or it is independent. In the first supposition the interior face is electrified positively when the exterior is electrified negatively, and *vice versâ*. The second supposition may be divided into three hypotheses, for we can admit that the interior is constantly, under the same circumstances, either neutral, or negative, or positive. Hence we have in all four hypotheses, *à priori*, namely: 1. Inner surface is dependent upon electric state of exterior. 2. Inner surface is independent and neutral. 3. Inner surface is independent and negative. 4. Inner surface is independent and positive.

Now of these four hypotheses, the fourth alone is verified by experiment. This I have established as follows: In one series of experiments I charged the exterior of the radiometer with positive electricity by exposing it to solar radiation. In a second series I charged the same surface with positive electricity by exposing it to solar radiation after moistening it with ether. Each experiment comprised two operations. I touched a certain number of times the exterior of the glass globe with the proof plane, and I carefully observed the electroscopic signs of the Böhnenberger electroscope when brought in contact with the proof plane; then I approached to the electrometer the glass globe which had been partially discharged by the preceding experiment, and I again observed the signs given by the electroscope. In the case that one of the first two hypotheses expresses the real state of the inner surface of the radiometer under the influence of radiation, on approaching the glass globe we should have, in both series of experiments, electroscopic signs of equal intensity for equal electric changes of the exterior surface, manifested by the equality of those of the proof plane. Now this does not take place. In my experiments on the approach of the globe, the electroscopic signs in the second series surpass in intensity those observed in the first series. These results agree perfectly with the fourth hypothesis, but are in open disagreement with the third. Any one can easily see this, with a little attention, by considering the layers of electricity produced in the interior of the glass walls by molecular polarization. The fourth hypothesis is, then, the true one, and the inner surface is electrified positively.

The explanation of both the direct and inverse rotation follows naturally from these facts and those communicated in my former note. For, since the inner surface, when exposed to luminous or calorific radiations, is electrified positively, the direct rotation is a necessary consequence of the attractions and repulsions which this positive electricity exerts upon the free electricity of the vanes. This rotation continues when the radiometer is surrounded by light, because a perfectly homogeneous layer of electricity upon the inner surface is almost impossible.

The inverse rotation occurs in two circumstances: 1. When the instrument, having been exposed to radiation which produces a direct rotation, is allowed to cool slowly. 2. When the radiometer at the ordinary temperature is cooled suddenly, for instance, by moistening it with ether.

In the first case, the electricity, which the globe acquires when exposed to radiation, disappearing very slowly, as experiments show, an inversion of the movement can be produced by an inversion in the signs of the electricity of the vanes. In fact, in accordance with the principle of reciprocity, the emission of the radiations gives rise in the vanes to a development of electricity equivalent and contrary to that which absorption has produced there. By this development of electricity, the vanes would return to their neutral state if the electricity produced by absorption had not passed in part from the vanes into the rarefied gas of the globe. Now this passage took place with a greater energy as the rotary movement of the vanes had renewed more frequently the mass of air in contact with them. Hence the electric effect of the emission will be to change the signs and to diminish the charge of free electricity of the vanes. In the second case, where the cooling is produced by moistening the exterior, the globe remains in its neutral state. For, as I have above remarked, during the whole time of the inverse rotation the cooled surface of the globe gives no sign of electricity. It appears that the cooling itself is not capable of producing electricity, but that the passage of a radiation through the surface is absolutely required. In these conditions, the vanes become charged with negative electricity upon the dark, and positive electricity upon the bright, side, by reason of the emission, at the same time that the radiations, given forth by the vanes and absorbed by the inner surface of the glass globe, electrify the latter positively. Thus the electric theory of the radiometer explains quite well the principal phenomena which have been observed up to the present time. I hope to make, hereafter, a study of all the particular movements which different observers have published in the *compte rendu* of their experiments. I will only say now that the most remarkable of them, namely, the rotation of the radiometer globe when an obstacle is put to the rotation of the vanes, as discovered by Schüster, is in entire conformity with the above theory, while it constitutes a very serious objection to the hypothesis of mechanical impulsion by radiation. JOSEPH DELSAULX, S. J.

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Petroleum as a Lightning Conductor.

The destruction of oil by lightning this year has been remarkable, amounting to 242,412 barrels, from January 1 to July 31 of this year, or rather from April to August; there were no fires from this cause in January, February, or March, two in April, none in May, four in June, and five in July. It is scarcely necessary to inform our readers that the oil destroyed is in closed-top iron tanks, and the lightning, striking these, explodes the gas that collects in the space above the oil, scatters the oil, and sets it on fire, and in this way often communicates to other tanks in the immediate vicinity. The theory most commonly received in the oil regions of the cause of such frequent lightning strikes is that the gas, which, it is well known, is continually escaping from the oil in these tanks, rises to some distance above the tanks, acts as a conductor, attracts the lightning, and the damage is done. One peculiar feature in the history of these accidents is, so far as we have been able to learn, no iron-topped tank has been struck, but in every case wooden-topped ones. We have made special inquiries on this point with the uniform result given. So far, attempts to protect tanks with lightning rods have been failures; at Dilks' Station, a number of rods, supposed to be ample protection, were placed about the tanks, but they were no protection against this summer's bolts. It may be interesting, to those not acquainted with the oil business, to state that, in losses occurring in this way, all the oil in the pipe line to which the tanks belong is assessed *pro rata* for the loss; that is, the law of general average, so well known in marine law, is applied in this case.—*Stowell's Petroleum Reporter.*

REMARKS:—If it were possible to carry the rods entirely above the rising gas, then the rods would be a complete protection. But the probabilities are that the rods mentioned were either immersed in an atmosphere of explosive gas, which the lightning necessarily ignited before it reached the rods, or the rods, like the majority that are put up, were not properly connected with the earth, consequently could not protect anything. A lightning rod not sufficiently joined to the earth is of no more use in conducting lightning than is a pipe with one end stopped up to conduct water.

We wish that some of our readers would give us the particulars of the rods at Dilks, describing especially the nature of the ground connections.

Explosive Agriculture—Dynamite vs. Plows.

The agents of M. Nobel, the well known inventor of nitroglycerin, have lately found a novel use for dynamite in grape culture, which suggests further possibilities. The explosive was not used for its chemical effect, but in a purely mechanical way, literally to "shake up" the earth and allow the free percolation of water and the access of air to the roots of the vines. To this end holes were made in the soil about ten feet in depth, and at points where no roots of the vines were likely to be injured. Then cartridges of dynamite were introduced and exploded, and the result was that, for the entire depth noted, the earth was made loose and friable. The ground, in short, was not only rendered in better condition than could have been effected by plow and harrow; but every phylloxera, so the writer says, on roots of the vines was killed. The quantity of dynamite used is not stated, but it is likely to have been but small, just enough to shake the soil without blowing up the vines.

It seems to us that the use of dynamite in agricultural operations need not stop here. Instead of breaking up old pasture lands with the plow with great labor, the farmer might bore holes here and there, drop dynamite cartridges, blow them up, and in a second find his soil loosened and all noxious worms and insects therein destroyed. Dynamite, however, is a dangerous material, and hardly one of which to counsel the indiscriminate use; but nevertheless it might prove a profitable venture for engineers and powder and nitro-glycerin manufacturers, and others who may safely and lawfully be trusted with the explosive, to offer their services in breaking up land for farmers.

PRACTICAL MECHANISM.

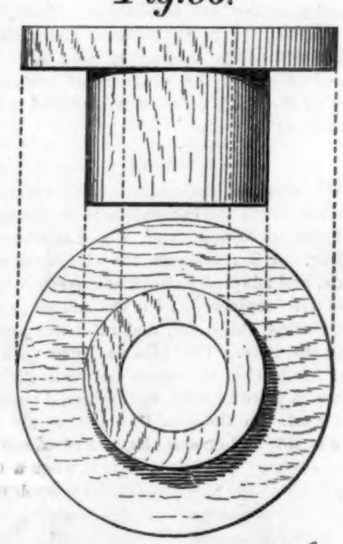
BY JOSHUA ROSE.

SECOND SERIES—Number XII.

PATTERN MAKING.

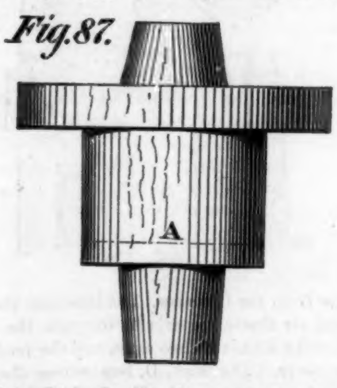
We may now commence a series of examples, accompanying each example with the explanations and considerations necessary to, and governing the method of, the construction chosen. Fig. 86 represents a drawing of a gland for which

Fig. 86.



a pattern is required. Now this is a very simple pattern, and yet there are at least six different methods of making it, any of which may be followed, as will appear more clearly to the reader by his glancing over Figs. 87, 89, 90, 92, 93, and 94. The first question is how to determine which method is the most suitable. Let us suppose the pattern maker to be uninformed of the purpose the casting is to serve, or how it is to be treated: in such a case he is guided partly by his knowledge of the use of such patterns, and a consideration of being on the safe side. The form shown in Fig. 87 would suggest itself as being a very ready method of making the pattern; by coring out the hole, it can be

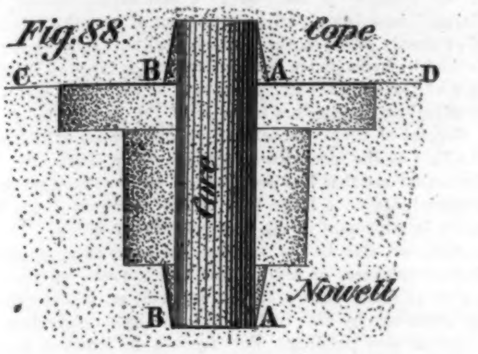
Fig. 87.



made parallel, which the drawing seems to require. The advantage of leaving the hole parallel is that less metal will require to be left for boring, in case it should be necessary; because, if the hole is made taper, the largest end of the bore will require to have the proper amount of allowance to leave metal sufficient to allow the hole to be bored out true, and the smaller end would, therefore, have more than the necessary amount: while just the least taper given to the exterior would enable the molder to withdraw the pattern from the mold. Made in this way, it would be molded as shown in Fig. 88, with the flange uppermost, because almost the whole of the pattern would be imbedded in the lower part of the flask, the top core print being all that would be contained in the cope; and even this may be omitted if the hole requires to be bored, since the lower core print will hold the core sufficiently secure in small work, unless the core is required to be very true. The parting of the mold (at C D, in Fig. 88) being level with the top face of the flange, much taper should be given to the top print (as shown in Fig. 87), so that the cope may be lifted off easily. Were this, however, the only reason, we might make the top print like the bottom one, providing we left it on loose,

or made it part from the pattern and adjust to its place on the pattern by a taper pin; but another advantage is gained by well tapering the top print, in that it necessitates the tapering of the core print at that end; so that, when the two parts of the mold are being put together, that is to say,

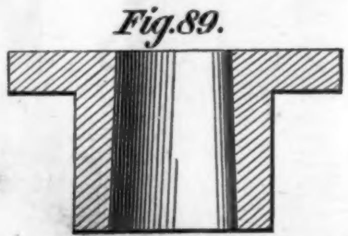
Fig. 88.



when the cope is being put in place, if the core has not been placed quite upright, its tapered end may still arrive and adjust itself in the conical impression, and thus correct any slight error of position of the core. The size of the core print should be, at the part next the pattern, the size of the core required; for if the extremities are made of the size of the core, and the taper or draft is in excess, there will be left a useless space around the core print, as shown at A B in Fig. 88, into which space the metal will flow, producing on the casting, around the hole and projecting from the end face, a useless web, which is called a fin, which will of course require to be dressed off the casting.

We will now suppose that our piece, when cast, is to be turned under the flange and along the outside of the hub or body, and that the hole also is to be bored. In this case the pattern made as above would still be good, but could be much more easily made and molded if it has to leave its own core, its shape being as shown in Fig. 89: because the trouble

Fig. 89.

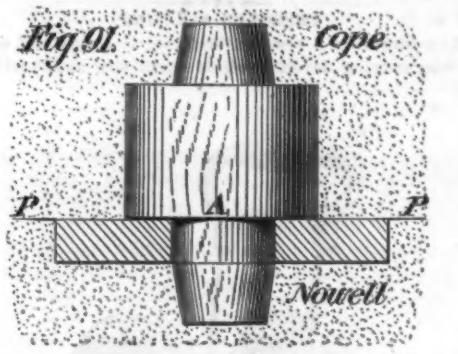


of making a core is obviated, and the core is sure to be in the center of the casting, which it seldom is when a core is used. We must, however, allow more taper or draft to a hole in a pattern than is necessary on the outside; about one sixteenth inch on the diameter for every inch of hight on work of moderate size is sufficient. The allowance for boring should be one sixteenth inch at the large end of the hole, providing the diameter of the hole is not more than five or six inches, slightly exceeding this amount as the diameter increases; whereas, if the pattern had been made with core prints, an allowance of one eighth inch for small, and three sixteenths inch for larger, work would be required. These are the advantages due to making the pattern leave its own core. We have still to bear in mind, however, that, if the casting require a parallel hole, a core must be used; and furthermore, if the hole is a long one, we have the following considerations: The separate dry sand core is stronger, and therefore better adapted to cases where the length of the hole greatly exceeds the diameter. Then again, if the hole require to be bored parallel, it can be more readily done if the hole is cast parallel, because there will be less metal to cut out. The casting also will be lighter, entailing less cost, providing it has to be paid for by the pound, as is usually the case. The molder is given more work by making the core; but the saving in metal and in turning more than compensates for this, provided the length of the hole is greater than the diameter of the bore.

Fig. 90.

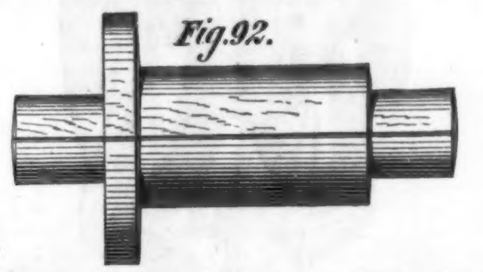
Let it now be required that the casting is to be finished all over, such as for a gland for a piston rod. It would, in that case, be preferred that, if the casting should contain any blow or air holes, they should not be on the outside face of the flange, and this will necessitate that the piece be molded the reverse way to that shown in Fig. 88: that is to say, it must be molded as shown in Fig. 91, with the flange downwards; for it may be here noted that the soundest part of a casting is always that at the bottom of the mold; and furthermore, the metal there is more dense, heavier, and stronger than it is at the top, for the reason that the air or gas, which does not escape from the mold, leaves holes in the top of the casting or as near to the top as they can, by reason of the shape of the casting, rise. The bottom metal also has the weight of the metal above it, compressing it, and making an appreciable difference in its density. It must, therefore, be remembered that faces requiring to be particularly sound should be cast downwards, or at least as near the bottom of the mold as they conveniently can. Following this principle, our gland will require to be molded as shown in Fig. 91, P P representing the line of the parting

Fig. 91.



of the mold; so that, when the cope is lifted off, the loose hub, A, will rise with it, leaving the flange imbedded in the lower half of the mold. It is evident that in this case the pattern must be made as shown in Fig. 90, the body and core prints being in one piece and the flange in another, fitting to an easy fit on to a parallel part on one end, and adjoining the core print, as shown at A. For glands of moderate size, this method is usually adopted, and it answers very well for short pieces; but in cases where the length of the body approaches, say three diameters, the horizontal position is the best, and the pattern should be made as shown in Fig. 92, 93, or 94. Even in short pieces, when the internal diameter approaches that of the external, this plan is the best, because it is difficult for the molder to tell when his core is accurately set in position.

Fig. 92.



For a pattern to be molded horizontally, Fig. 93 shows the best style in which it can be made. Its diameters are turned parallel; the required draft is given by making the rim of the flange a little thinner than at the hub, and by making the end faces of the hub and the core prints slightly rounding. If the hub is very small, as, say, a half inch or less, and the flange does not much exceed it, the pattern may be made solid, as shown in Fig. 92; but if the hub be small and the flange large, it should be made as shown in Fig. 94.

Fig. 93.

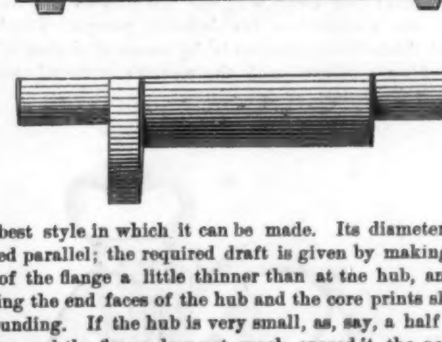
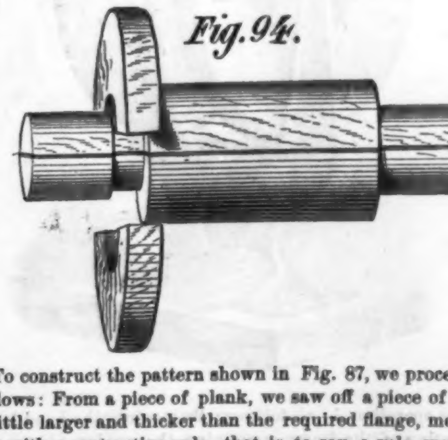
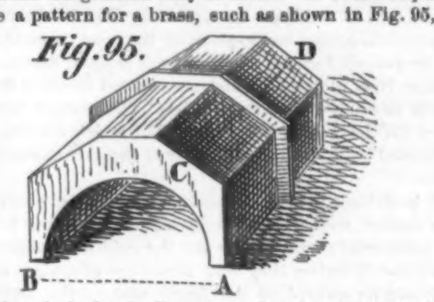


Fig. 94.



To construct the pattern shown in Fig. 87, we proceed as follows: From a piece of plank, we saw off a piece of wood a little larger and thicker than the required flange, measuring with a contraction rule, that is to say, a rule specially made for the pattern maker, and having its measurements larger than the actual standard ones in the proportion of one eighth inch per foot: so that a foot on a contraction rule is $12\frac{1}{8}$ standard inches, and an inch is $1\frac{1}{96}$ standard inches. The reason for this is that, when the metal is poured into the mold, it is expanded by heat; and as it cools, it contracts, and a casting is, therefore, when cold, always smaller than the size of the mold in which it was made. Brass castings are generally said to be smaller than the patterns in the proportion of one eighth per foot, and cast iron castings one tenth inch per foot; and so, to avoid frequent calculations and possible errors, the contraction rule has the necessary allowance in every division of the foot and of the inch. It is not, however, to be supposed that the possession of such a rule renders it possible for the pattern maker to discard all further considerations upon the contraction of the casting; because there are others continually stepping in. Such, for example, is the fact that the contraction will not be equal all over, but will be the greatest in those parts where the casting contains the greatest body of metal. If we are required to make a pattern for a brass, such as shown in Fig. 95, its

Fig. 95.



bore being six inches in diameter and its length ten inches, we shall find that the diameter of the casting will be less at A B than can be accounted for on the basis of a contraction of one eighth inch per foot; and furthermore, the projection in the middle of the brass, which is sometimes provided instead of flanges to prevent the brass from moving endwise in the box, will cause the sides of the hexagon to cast hollow in their lengths; so that a straight edge, placed along the bevel from C to D, would touch the brass at each end, and not in the middle.

In the smaller sizes of patterns, however, such as those of 6 and less inches in diameter, there is another and a more important matter requiring attention, which is that, after a molder has imbedded the pattern in the sand, and has rammed the sand closely around it, it is held firmly by the sand and must be loosened before it can be extracted from the mold. To loosen it, the molder drives into the exposed surface of the pattern a pointed piece of steel wire, which he then strikes on all sides, causing the pattern to compress the sand away from the sides of the pattern in all directions; and as a result, the mold is larger than the pattern. In many kinds of work, this fact may be and is disregarded; but where accuracy is concerned, it is of great importance, especially in the matter of our example (brasses for journals), for they can be chipped and filed to fit their places much more rapidly than they can be planed, and it is necessary to have the castings as nearly of the correct conformation as possible. In cases where it is necessary to have the castings of the correct size without any work done to them, the shake of the pattern in the sand is of the utmost importance. If he is required to cast a piece of iron 3 inches long and 1 inch square, supposing the pattern were made to correct measure by the contraction rule, the molder, by rapping the pattern (as the loosening it in the mold is termed), would, by increasing the size of the mold above that of the pattern, cause the casting to be larger than the pattern: that is to say, it would be longer and broader, and therefore, in those two directions, considerably above the proper size, since even the pattern was too large to the amount allowed for contraction. The depth, however, would be of correct size, because the loosening process or rapping does not drive the pattern any deeper in the mold. It follows that, to obtain a casting of as nearly the correct size as possible, the pattern must be made less in width and in length than the proper size, to the amount of the rapping; and to ensure that the molder shall always put the pattern in the sand with the same side uppermost, the word "top" should be painted on the face intended to lie uppermost in the mold. The amount to be allowed for the rapping depends upon the size of the pattern, and somewhat upon the molder, since some molders rap the patterns more than others: hence, where a great number of castings of accurate size are required, it is best to have two or three castings made, and alter the pattern as the average casting indicates. For castings of about 1 inch in size, the patterns may be made $\frac{1}{32}$ inch too narrow and the same amount too short; but for sizes above 6 inches, allowance for rapping may be disregarded.

In patterns for small cast gears, the rapping is of the utmost consequence. Suppose, for instance, we have 6 rollers of 2 inches diameter, requiring to be connected together by pinions, and to have contact one with the other all along the rollers: if we disregard the allowance for rapping, the pinions will be too thick, and we shall require to file them down, entailing a great deal of labor and time, besides the rapid destruction of files.

Garden Bulbs.

Now is the time when bulbs should be taken up and stowed away, as the leaves of the plants become ripe and brown, and the roots will die if the plants remain too long in the ground. The bulbs should be put away in the shade to dry for a few days; then the tops, roots, and rough skin should be removed, and the bulbs put in paper bags, properly labeled. Bulbs that have flowered in water should, as soon as the flowers begin to fade, be removed and planted in earth, where they will get a little nourishment for the future good of the bulb; but even then the bulbs is weakened, and bulb will not flower as well in water twice, though they will serve for planting in the garden.

IMPROVED CROSSHEAD FOR LOCOMOTIVES.

Mr. W. A. Alexander, the inventor of the new locomotive link which we recently illustrated, has also devised an improved crosshead for locomotives, which is represented in perspective, Fig. 1, and section, Fig. 2, in the accompanying engravings. The general object is to render the crosshead easily adjustable at the wristpin and jaws, so that a close fit and steady motion in the guides are obtained, and so that the device will possess greater durability. The crosshead is cast in the usual manner, and has side recesses back of the piston rod socket, for the insertion of the detachable wristpin, A. The latter is turned true in the lathe and is fitted into the recesses by side guide plates, which are secured by pins to the jaws of the crosshead. These jaws are not planed square, but are made at a slight angle to the horizontal axis of the head, as shown in Fig. 2. In relatively opposite directions on the sides of the jaws, tapered wedges, B, are placed, forming a square base support for the top and bottom steel plates, C, which are secured firmly to the crossheads by countersunk steel bolts. The wedges have apertures for the passage of these bolts, which are loosened or tightened by a key introduced into interior recesses of the jaws.

It is claimed for the invention that one pair will outlast any engine, and effect a saving of fifty per cent in repairs of connecting parts, that when the guides are once set true with the cylinders they will never need relining, and that they can be secured to the frame without the intervention of liners. The mode of obtaining a perfect alignment of the crosshead and guides with the cylinder will be seen from

Fig. 1

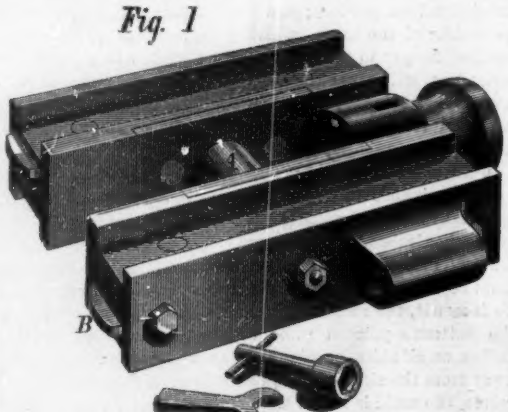
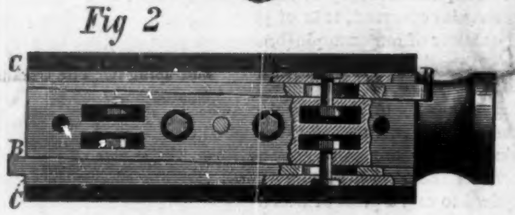


Fig 2



the following. The center line on the jaw of the crosshead, is cut in when on the planer, the guides being fitted and set true with the cylinder without liners, and secured with bolts or rivets and steady-pinned, and may be taken down and planed off the entire length whenever necessary, and replaced without the necessity of relining. The crosshead being in place, with the adjustable keys loose, is set true with the guides, with the rule, caliper, or compass by the center line on the jaws of crosshead. Thus it will be seen that no matter whether it be the guides or the jaws of the crosshead that are worn, it is only necessary to take up the wear with the adjustable keys, setting the head by the line, to insure both guide and crosshead being in perfect line with the cylinder. The piston rod and pump rod, it is further claimed, cannot get out of line, thus securing immunity from the breaking of pump lugs and the cutting away of the crosshead eye by the piston rod. The adjustable wrist pin gives at all times a round pin, effecting a great saving in the cost of brasses, oil, etc., and obviating a great amount of friction. Whenever it becomes necessary to take the piston rod out, by removing the wrist, direct access may be had to the end of the rod in order to back it out. These wrists can be made of cast steel at a very slight advance on the cost of cast iron.

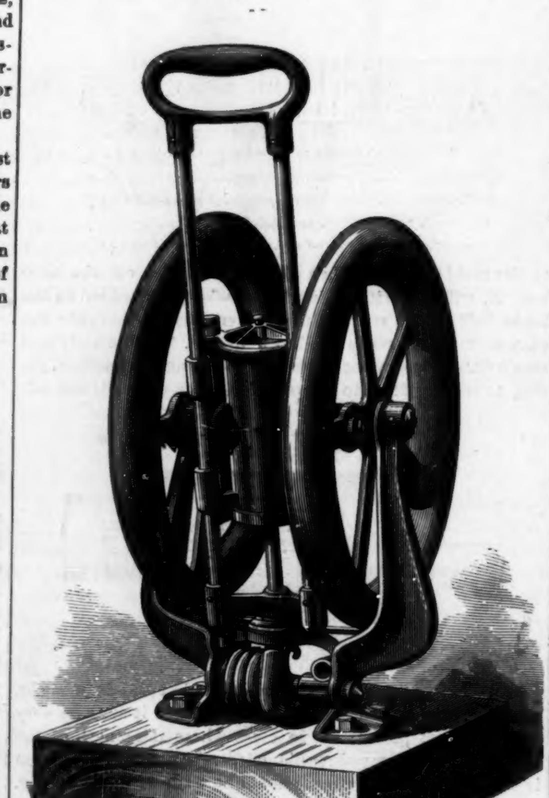
Patented through the Scientific American Patent Agency, October 6, 1874. For further particulars address the inventor, W. A. Alexander, P. O. box 130, Mobile, Ala.

Repairing Leaky Cellar Walls.

The season now at hand is the one most important for making cellars dry and cleanly. In fact, the repairing of leaky cellar walls should never be delayed, since the crevices are continually widened by the water soaking through. Cement, tar, and water glass are the best materials for the purpose, but the last two can only be used at a time when the cellar is dry, as in winter, perhaps even in September, or after drying and airing it in winter by artificial means. When nearly dry, the leaky portions of the wall can be readily recognized, and should be marked with charcoal. Holes and cracks should first be filled with hydraulic cement. The marked places, when dry, should be coated three to four times with a solution of 1 volume of commercial water glass in 2 of water, and finally, after becoming perfectly dry, with a solution of 1 volume of water glass in ½ volume of water. Instead of the solution of water glass, tar, kept quite liquid by heating, may be laid on a number of times If cement is to be employed, the marked portions of the wall should be cut out wedge-shaped, and carefully filled with a cement, rather thickly made up, with ½ sand. If the cellar cannot be dried, the moist places should be cut out somewhat deeper (4 to 6 inches), and filled with cement, by placing a tube of material, about as thick as a finger, in the middle, and packing the cement in tightly around it, and, if necessary, holding it in place with a board until it hardens, while the water escapes through the tube without exerting any pressure upon it. After 20 to 30 days, the opening may be plugged up.

IMPROVED AIR PUMP.

The invention herewith illustrated is a new and simple air-compressing device, made of small size and excellently



adapted for use wherever liquids are to be raised by air pressure, and similar light work is to be done.

The general arrangement, as seen from the illustrations, is that of an oscillating engine, with the difference that in this pump the cylinder moves up and down, and the air is discharged or exhausted through the hollow piston rod, according as the pump used for purposes of plenum or vacuum. This arrangement does away with the complicated pipe connections, etc., necessary on double-acting pumps. The lower end of the hollow piston rod is, by means of a piece of flexible tubing, connected with the receiver or vessel operated upon by the pump.

The operation is as follows: By moving the hand lever, consisting of the frame containing the guides, piston rod, and piston, the two flywheels are rotated, and the momentum acquired by these is sufficient to bring the cylinder to a point where the resistance of the compressed air is equal to that in the receiver. At this point the guides (on hand lever) and the crank (formed on the flywheels) stand at such an angle as to work like a toggle joint and press the cylinder to the end of its stroke with great force. The same repeats itself in the other half of the rotation. All the bearings are amply large, of cast steel, and exactly in line, as the pumps are made by special tools. The clearance at top and bottom of the cylinder is reduced to a minimum, thereby, it is claimed, insuring a perfect expulsion of air; the valves are of expressly cured leather, which does not become hard, and backed by brass plates; said valves are as large as the diameter of the cylinder and piston will allow. The piston and stuffing box packing are likewise of the best material.

Several of these Centennial pumps are on exhibition at the Fair of the American Institute, New York city. We learn that one that has been in hard use for seven months in Philadelphia, in a large beer saloon, without being taken apart, is at present in the best possible condition. The manufacturer also builds vacuum gas-condensing pumps for higher pressure, or simple gas transferrers, on the same styles as those shown in the engravings, whose cylinders are from two by four inches up to six by seven inches.

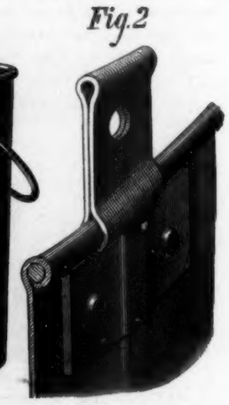
Patent now pending. For further information apply to H. Weindel, 460 Dillwyn street, Philadelphia, Pa.

IMPROVED BUCKET EAR.

We illustrate herewith a new ear for buckets, kettles, coal hods, etc., which is constructed so as to be very strong and not liable to be torn out. Its application to a bucket is shown in Fig. 1. From Fig. 2 it will be seen that the ear is formed of a piece of any suitable metal, stamped or cut out, and bent in the middle so as to form a loop and clasping pieces, which extend, one on the inside, the other on the outside, of the bucket. The plate is so pressed that a groove will be formed to fit around the wire at the top of the vessel, and also so that it may be attached over a seam, as

Fig. 1

Fig. 2



shown. The rivets then pass through the side of the vessel and through both parts of the ear.

Patented June 27, 1876. For further particulars address the inventor, Mr. Joseph F. Donkin, St. Clair, Schuylkill county, Pa.

Metals Absorbed by Plants.

Professor P. B. Wilson has shown that plants take up free silica from the soil, in the form of diatom shells, which are deposited in the stalks of the plants. In a Dutch technical journal, Dr. De Loos states that vegetables are capable of taking up metallic particles from the soil. Consulted by a family suffering from lead poisoning, he found that they resided in the neighborhood of a place where the manufacture of white lead had been carried on some years previously, and they partook of vegetables grown on the spot. Dr. De Loos thereupon examined specimens of red beet, endive, and carrots, and found lead in all. In a beet weighing 1·43 lbs., he found the equivalent of 0·15 grain of metallic lead; in six carrots, weighing together 0·6 lbs., he found 2·7 grains of lead. The metal was also present in endive; and the ashes of the plants contained traces of copper, which, he thinks, existed as an impurity in the lead.

A New Electric Fire Alarm.

A new electric fire alarm, devised by M. Gaulne, of Paris, was recently described at a session of the Belgian Society of Civil Engineers. A metal box, fixed to the wall or ceiling of the room, has two metal columns which receive the conducting wires from below, and to which are attached two sensitive plates, the upper ends of which meet near the summit of the box at an acute angle when brought together. Each plate is made partly of steel and partly of an expansible metal, the steel being on the inside and extending to the end of the plate, the expansible metal being the shorter. The effect of heat on these plates is to cause the outer metal to expand; and the steel ends being brought in contact, connection is established between the wires, and a bell is sounded.

Besides serving as a fire alarm, the invention is intended to act as an ordinary call bell, and to this end a vertical rod, spring-supported, has at its upper extremity an index which, when the rod is drawn down by a cord similar to a bell pull on its lower end, rubs against the sensitive plates and thus establishes the current.

The degree of expansion of the outer metal of the plates being known, it is only necessary to approximate the ends more or less closely to cause contact to occur at any thermometric point and the bell to sound. A needle attached to one plate moves over a dial marked with degrees and fractions This plate is moved toward or allow to spring from the other by means of a regulating screw, and thus the needle may be adjusted at any degree.

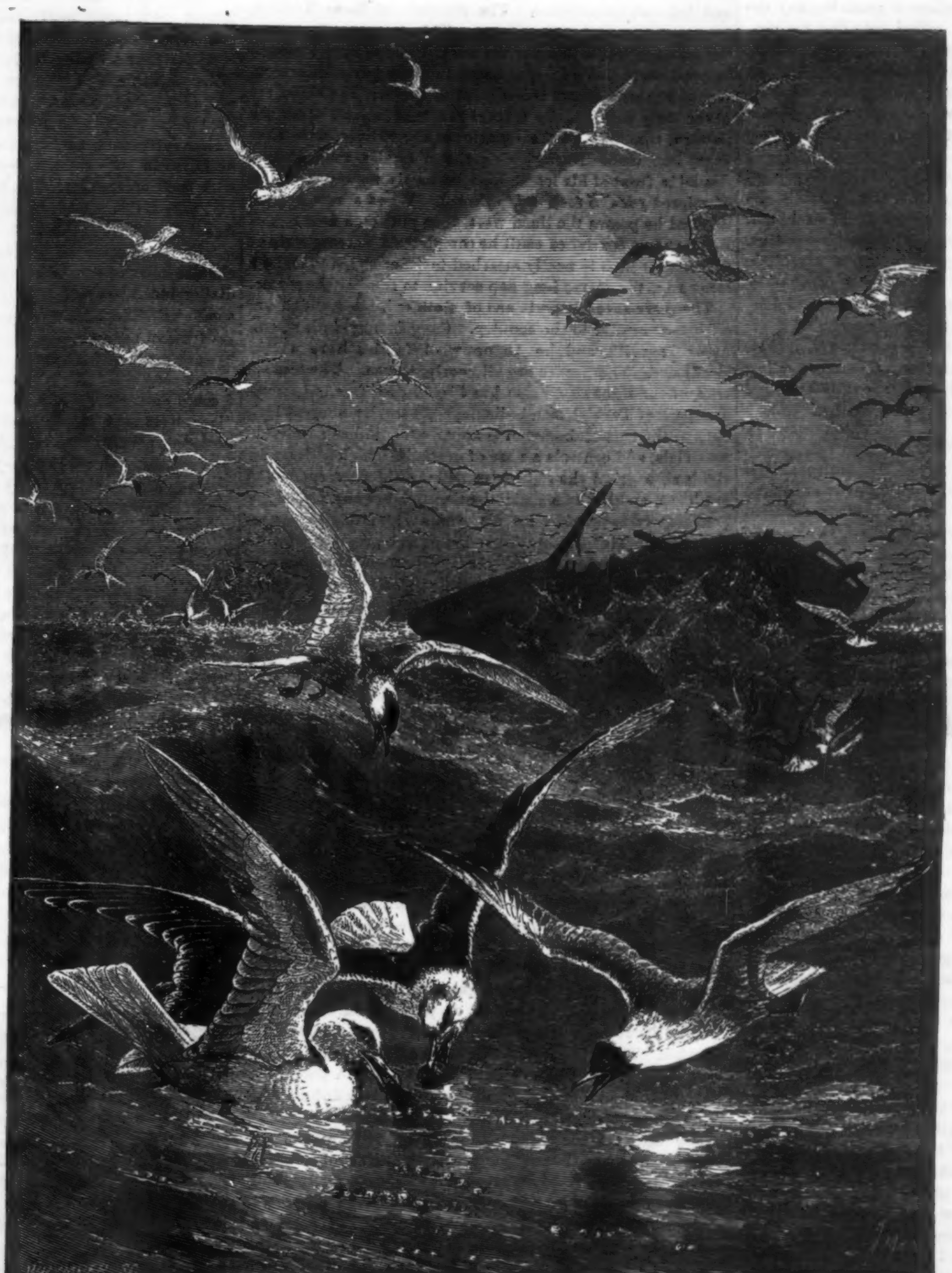
THE SEA GULL.

A traveler, making his first voyage across the ocean, is astonished to find birds following in the ship's wake a thousand or more miles from land. That such small animals should be gifted with the endurance necessary for keeping on the wing for a week continuously, with the exception of an occasional rest on the surface of the ocean, is certainly an extraordinary proof of the muscular power and vitality of this species of the winged tribe.

These birds are nearly all members of the gull species (*larus*, of Linnæus), of which the largest *genera* are *larus glaucus* (Brünnich), which measures 30 inches in length, and has a wing breadth of 5 feet, and the *larus marinus* (Linnæus), which is nearly or quite equal in size to the *l. glaucus*. The gull family has several general characteristics, among which may be mentioned the curvature at the end of the bill, the length and pointed form of the wings, and the web between the toes, the hind toe being short and elevated. The *l. marinus*, commonly called the black-backed gull, may be distinguished by the dark slate color of its back and wings, its black primary feathers tipped with white, and its yellow legs and feet. This species is found in summer on the coasts of New England, and in winter travels as far south as Florida, its favorite breeding places being on the coast of Labrador. It flies high, and has a majestic carriage in the air: it encounters the fiercest gales, and swims well but slowly. It preys on fish, young birds, and carrion, indeed on anything but vegetable food; it is tyrannical towards weaker birds, but is naturally very cowardly. Its eggs are good eating, and the young birds are killed and salted by the fishermen of Labrador and Newfoundland; but the old ones are very tough and too fishy in taste for food.

Our illustration* shows a flock of black-backed gulls surrounding a wreck, and hurrying with screams of delight after small pieces of garbage or refuse food that float away from the wrecked vessel. Mr. Wolf, the artist, shows well the great wing power of these birds, and the easy grace with which they carry themselves in a gale. Their endurance in flight is aided by the lightness of their bodies, which, however, makes them the sport of a high wind; but this obstacle they overcome by a novel species of tacking, which enables them to make headway against the tempest.

Many of the high rocks and almost inaccessible cliffs of Scotland and North Wales are the homes of countless millions of sea birds; and the pursuit of them, for their eggs and plumage, is one of the most hazardous pursuits in which men ever engage



THE GLEANERS OF THE SEA.

Feathers.

The natural color of feathers is produced by the internal arrangement of the colorless plates of horny matter, and not by any pigment. This is also the cause of the iridiscence or varying shades of color on beetles' wings and some nacreous shells; the different thickness of the horny films interferes with the light, and produces the play of colors. Almost any artificial color can, however, be given to feathers by dyes. "When," says Professor Owen, "the barbules are long and loose, they characterize that form of the feather which is properly called a 'plume,' and such are the most valuable products of the plumage of birds in a commercial point of view." The annual quantity of bed feathers used in the United Kingdom has been estimated at nearly 700 tuns, a very large quantity when the lightness of the substance is taken into consideration. The foreign imports only amount to a few thousand hundredweight. Feather beds being a fruitful source of contagious disease, the feathers are frequently sent to the purifiers, where they are subjected to steam and dry heat, and again rendered perfectly sweet and pure. In making a nest for her young by robbing her breast of its downy covering, the eider duck has little thought of ministering to the luxurious requirements of civilized man, who appropriates it for his comfort. As much as 1,200 lbs. of this down is often sold annually by one company from Greenland; and when clean and pure, it fetches from $6 to $6.50 per pound. The export of eider down from Denmark, the produce of Iceland, Greenland, and the Faroe Islands, averages 6,000 to 8,000 lbs. weight a year. Paris enjoys a high reputation for the preparation, bleaching, dyeing, and arrangement of feathers, a great number of persons being employed in the feather trade, which was stated to have reached, before the late war, an annual value of nearly two and a half million dollars. The largest portion of these were exported to America and the colonies. A new and very pretty ornamental application of feathers, etc., is that of the entire head and plumage of some birds for fans and fire screens, instead of the mere feather trimming which was formerly applied to fans; and the brilliant heads of the humming bird family, set as necklets, ear pendants, brooches, etc., form a novel species of bird jewelry. Feather flowers are chiefly made at Madeira and in Brazil, but the latter are the best, and fetch a higher price. At Bahia the Solidade Convent is the great *locale* where they are made. They ought to be made entirely of undyed feathers, the best being those of a purple, copper, or crimson color, from the breasts and heads of humming birds. One of these wreaths has a beautiful effect, and reflects differently colored lights. The cocks of the rocks, white herons, roseate spoonbills, golden jacamars, metallic trogons, and exquisite little seven-colored tanagers (*calaspiga tatas*), with many gay parrots and other beautiful birds of the country, offer an assortment of colors capable of producing the most exquisite effects. The feather work is often applied with a pretty effect to the borders and fringes of hammocks. Examples of these, with the arms of Portugal or Brazil, have been frequently shown at the several International Exhibitions.

A celebrated brush manufacturer in Paris makes brushes from quills, which he splits by a mechanical process into thin strips, much resembling bleached bristles. Besides the neat appearance of this article, it possesses the advantage, over the common hair or whalebone brush, that its single fibers are more dense and solid, while the bristle represents a hollow tube.

Progress of Railroad Building.

One of the most encouraging features of the fall trade is the increase in the railroad building that is going on. The Chicago *Journal of Commerce* has a summary, from which we quote: "At the East a narrow gage road, nine miles long, has been commenced between Boston and Stoneham, that will cost $300,000. A road following the valley of the Lamoille river, in Vermont, is being ironed, and will be opened to Lake Champlain this fall. The Rochester, N. Y., road will reach Salamanca this year, and be pushed forward to the coal fields of Jefferson county in the spring. The Columbia and Port Deposit, Del., road has twenty-five miles of track laid, and is pushing ahead actively. The Portsmouth and Huntington, Ohio, to give the Scioto Valley an Eastern and Western connection, and obviate the delays of Ohio river navigation, only waits until it is decided whether the gage shall be common or narrow; and the Harrisonburg and Fredericksburg, Va., having been changed to a three-foot gage on the completed portion, will be pushed forward and completed from Orange Court House to Rawley Springs at once. A coal tributary of the Scioto Valley road has been surveyed, commencing a dozen miles above Circleville. The Cincinnati and Portsmouth having adopted a narrow gage will advertise for its roadway at once. The Cincinnati Southern has contracted for rails to complete the way to Lexington, Ky. The Federal Creek, O., coal road, eighteen miles, has its bed completed a part of the distance and is expecting iron. The Rock Island and Mercer county, Ill., striking the eastern portion of the country, is laying track and using it. The Omaha and Northwestern, completed to Herman, is being constructed at the rate of half a mile a day toward Tekamak. The Kansas and Northwestern narrow gage road is open forty-four miles to Lexington, Mo. In the South funds are being raised to extend the Mobile and Alabama road seventy-eight miles, from Uniontown to Birmingham, with a promise of speedy success. The gage of the Houston and Texas has been changed to 4 feet 8½ inches for 120 miles between Houston and Hearne, making it uniform through to Philadelphia and New York. Track laying has recommenced at Kingsbury, on the Galveston, Harrisburg, and San Antonio road, advancing toward San Antonio. Utah is solicitous of commencing a road from the Union or Central Pacific, by the valleys of the Snake and Columbia rivers toward Portland and Puget Sound, and one is to be surveyed along the Colorado Valley, with the hope of reaching San Diego. The Tomales, Cal., road to Freestone, Sonoma county, will reach Russian river this fall. Colorado is also at work on a narrow gage from Floyd Hill, terminus of a branch of the Central, to Idaho and Georgetown, that will branch to Central City and be extended into the Middle Park.

A New Use for Sea Weed.

Hai-thao, or gelose, is a tasteless, odorless, colorless mass, obtained from a fibrous sea weed common on the coast of China and Mauritius. It is insoluble in cold water, but dissolves in hot water after boiling for ten minutes, and then forms a thin, dirty white solution, which, on cooling, deposits a yellowish gray jelly. The material has lately been used for finishing cotton fabrics, and is reported to fill the thread more perfectly than dextrin or starch. By adding glycerin to the hai-thao solution, a still softer and at the same time stronger material is obtained. According to experiments made by Heilmann, an abstract of which is given in Dingler's *Polytechnisches Journal*, it appears that the material can only be employed for fine textures, soft and firm to the touch, and cannot be used as a substitute for dextrin or potato starch where a strong material is required.

* Our engraving is selected from Mr. Wolf's "Life and Habits of Wild Animals," published by Macmillan & Co., of London and New York.

CENTENNIAL NOTES.

THE BELGIAN WOOLEN MACHINERY.

Bede & Co., Verviers, exhibit a fulling machine for cloths and woolen stuffs, such as flannel. Five or six pieces of fine cloth or three pieces of military cloth can be treated at a time, and the entire mechanism is arranged so as to be of easy access to the workman. The same firm exhibits a machine for cleaning wool, which is represented to be an improvement on the American invention, and the manufacturers have supplied several factories in this country with machines of this kind. It is said to clean 250 lbs. per hour, and with an automatic feeding apparatus one man can attend it. All kinds of wool may be cleaned by it. Those for carding are worked dry, and those for combing in a damp state. A carding machine with a patent condenser is also exhibited by Bede & Co. It is fitted with cast iron cylinders, carefully turned. The patent condenser produces any desired number of slivers, which are rolled into fine rovings, and the latter may be spun direct to 1,000 yards per ounce. It is claimed that the usual waste of carding is avoided by this condenser, and that more is done with it because there is no necessity of roving or drawing halfway. The condenser can be used for all kinds of wool, from the shortest to the best merino.

Wool-spinning machinery invented by Celestin Martin, of Verviers, a distinguished Belgian inventor, recently deceased, is exhibited. He was a poor working machinist, who, through his mechanical skill and inventive genius, worked his way to the head of a great industrial establishment, and won from the King of Belgium the offer, twice refused, of the decoration of Chevalier of the Order of Leopold. His *métier fixé* or stationary spinning machine is exhibited with other machinery for wool manufacture, including a model for a new carding machine. There are a few wool-carding appliances shown by other exhibitors, and Horstmann Brothers, Liège, exhibit carding cloths.

THE FLORAL AND BOTANICAL DISPLAY.

The display of plants in the vicinity of Horticultural Hall is said to be the finest collection of the kind ever exhibited in this country. The flower beds are all made in different shapes and designs. Some are carpet bedding, so arranged as to display the figures of a carpet; others are ribbon bedding, in strips, made to secure the effect of ribbon, while the walks are laid out in geometrical and winding figures that make the place look very beautiful. In the western section of the grounds there are nearly 70,000 plants laid out, so the reader can easily imagine the result attained.

To the American exhibit are devoted 239,173 square feet, and 45,000 square feet to the foreign. The American exhibit is composed of 59,500 plants, and the foreign of 10,233. A magnificent display of the agave, or American century plant, and lemon and orange trees bearing fruit, immense sugar canes, crape myrtles—a little shrub bearing an exquisite pink flower—are on these grounds. The flowering plants embrace, among a legion of varieties, hollies, rhododendrons, roses (600 plants), gladiolus, magnolias, lilies, tulips, azalias, begonias, caladium, dahlias, geraniums, carnations, pansies, and hyacinths. Then there are the yuccas, coleus, fir trees, evergreens, and various deciduous and succulent plants.

All kinds of landscape gardening are represented. In one section of the grounds is a complete arboretum, embracing 750 different species. The flower beds, to which allusion has already been made, are made of achyanthus, centoria, alternanthera, golden feather fen, Madagascar periwinkle, gladiolus, cannas, petunias, caladium, and the castor oil bean plant.

Among the more striking trees and plants, there is a tall mahogany tree, looking like a giraffe among its fellows. The *cinchona succirubra* is one of the most valuable plants in the collection. From its bark the drug quinine is manufactured. The East India apple tree is a rather attractive-appearing shrub. The alligator pear tree yields a rich, large fruit, which the natives use instead of butter. The *Strelitzia requia* is a large plant bearing a large flower shaped like a bird's tongue and beak. The flowering banana is here in full bloom.

Coffee trees are abundant, and also the fan palm, with leaves ranging all the way in size from the ordinary palm fan to the size of a center table. With the latter leaf the people of the tropics thatch their houses. Loquat is the name of a peculiar, dark-looking Japanese plant with rich fruit. There is the common fig tree, and the *ficus Australis*, with aerial roots growing down from the branches like flowing hair. The moisture in the air affords them sustenance. The Chinese wampee fruit tree and the papyrus plant attract a good deal of attention. Many specimens of the *bambusa* (the bamboo tree) are on exhibition, some of them very high. The *eucalyptus globulus* is the fever tree of the tropics, and is highly prized because it absorbs all the malaria in the air. The *icica Indica*, or incense plant, is so called because it yields a sort of perfumed gum which is used for incense. There are also some very fine specimens of the *ficus micophylla* or india rubber tree, a plant which is pretty well known in this climate.

THE TURKISH SECTION.

If one might judge from the lavish profusion of so-called Turkish goods exhibited for sale in booths located almost at every turn, both within and without the grounds, Turkey is by far the best represented nation in the entire Exposition. Unfortunately for whatever credit the fact might bring, the majority of the small objects displayed evidently originated in that great mart of imitation jewelry and storehouse of all strange articles, from Chinese idols to Maori nose rings, Birmingham, England. Those not derived from this source are unmistakably French, while carpets savor more of German looms than those of Smyrna. A perfume of geranium oil, supposed by the uninitiated to be attar of roses and purchased as such at ten times its value, pervades the booths, and the oriental glamour is hightened by the Gibraltar Israelites and Bohemian Greeks, who assume the *rôle* of genuine Moslem salesmen. The stands, however, are extensively patronized, principally by visitors from the country seeking mementoes of the Exposition. Compared with this spurious display, the genuine Turkish exhibit, though excellent as representing the country, is small. Great carpets woven on the hand loom, in which no improvement has been made since the days of Mahomet, hang from the roof. The patterns are as old as the manufacture, but they are delightfully ugly and resplendent with their outlandish shades of red and queer blue-greens, dear to the antiquarian and *bric-a-brac* collector. The choicest of these Turkish rugs are apparently the coarsest. This last quality attests the genuine production, for the finer rugs are now imitated in great perfection on power looms in many parts of Europe. A real Turkish carpet is irregularity itself. The sides are never truly parallel, the texture rarely even; and as for the pattern, that follows the vagaries of the weaver, who takes every imaginable liberty with the normally rude design. Seated in front of his loom, he laboriously fastens a bunch of colored yarn to each warp thread. When a row is thus finished he passes the linen weft, then puts on a new row of tufts, and so continues until he completes a narrow strip of carpeting, which is neatly attached to other strips to make a large rug, the coarse long nap serving to conceal the seams.

There are several specimens of cloth exhibited which are likewise peculiar to the country. Camel's hair cloth resembles coarse silk, and the Angora wool fabrics have a like similarity. The tissues are all poorly woven. The same is true of the light silks, also handwork. In fact, wherever the work of Turkish men is displayed, there the inherent laziness of the true Mahometan is apparent. He has admirable materials, and controls a class of goods in which he has few rivals abroad; but the repressive policy of his government on one hand, and his own disinclination to labor any more than is necessary to provide for his wants from day to day on the other, effectually block his industrial progress, and he contributes nothing toward the advancement of the age. With Turkish women, if the results of their labor be taken as a standard, the case is different. They work, high and low alike, as a relief to the dreary existence to which their social position consigns them. The magnificent embroideries on silk, the gold thread stitching on velvet, and similar productions proving patience and skill, are mostly made in the harems, and by women ignorant that such a thing as education exists.

Turkey is the land of the far-famed attar of roses, and the visitor may buy, or rather may imagine that he buys, a minute bottle, holding three drops of the extract, for two dollars. The genuine attar does not appear to be exhibited, although it might be, for it can be found by the pint in the Constantinople and Smyrna bazars. The material at the Exposition comes from Kizanlik in Roumelia. It probably is olive, sandal wood, geranium, or other oil, perfumed with a minute quantity of the genuine article, as such is the compound most commonly sold the world over as the true attar. The latter, if genuine, is worth between $50 and $100 per per ounce, and to make that quantity 400,000 full blown roses are needed. The mode of preparation consists in boiling the roses in water and gaining the oil through distillation. The oil is volatile, nearly colorless, and deposits a crystalizable substance soluble in alcohol. A drop of it on the handkerchief perfumes the fabric indefinitely, despite numerous washings.

The best industrial productions displayed are the thin leather known as Turkey morocco, specimens of prepared opium, dried figs from Smyrna, gall nuts used for ink making, and various dye stuffs. There are a large number of ancient arms, some superbly inlaid in mother of pearl and silver, showing that the old Turks possessed a manipulative skill and a degree of patience which have not descended to their posterity. Turkish tobacco is likewise exhibited, and visitors are permitted to purchase a poor quality for a high price. The best Turkish tobacco is worth here from $4 to $8 per pound. The Turks themselves favor a Persian tobacco much more than the finely shredded material sold as Latakia or Scarfalatti. The former is used mainly in the nargilehs or water pipes, looks like dried oak leaves, tastes like them, and has to be moistened before packing in the pipe bowl; and then the constant attention of a servant is required to keep live coals on the damp mass, otherwise the fire promptly goes out. It therefore takes two persons' labor to keep the pipe lit, and their accumulated energy is represented by a scarcely perceptible whiff of faintly blue smoke, which is swallowed or inhaled before escaping from the mouth.

One of the best exhibits in the Turkish department is the sponge collection, and this represents a really important industry, which flourishes despite the unlimited taxation imposed upon it. Sponges of all varieties are exhibited, some marvelously fine. As might be expected, books are few, and such as are present are poor specimens of both printing and binding.

Zinc Roofing.

A controversy is just now going on in Germany as to the durability of zinc used for roofing purposes. The *Zeitschrift für Gewerbe* reproduces the calculations as to the durability of zinc made by Dr. Pettenkofer in Dingler's *Journal* some years since, but points out an error in them. Rectifying these afresh, on the basis that the oxidation of 1 square foot reaches 130 grains in 27 years, the *Zeitschrift* finds that a sheet of zinc $\frac{1}{10}$ inch thick would occupy 1,243 years in complete oxidation. A weight of 130 grains of zinc spread over the surface of a square foot would make a layer only $\frac{1}{5000}$ of a line thick. If the sheet be 0·25 line thick, there will be 46·04 such layers, and this, multiplied by 27, gives 1,243, the total number of years.

RAMBLING NOTES.

NUMBER II.

A GEAR-MARKING DIAL.

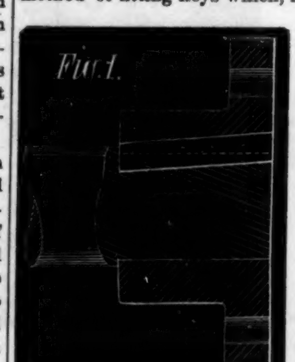
"I was up in George's pattern shop a few days ago. He was showing me a dial plate, which he had just gotten up for his gear pattern work. It is the neatest affair I have seen lately, and seems to be a real money-saving device. It is simply a cast iron dial fitting the spindles of the pattern lathes. It is machine-divided for all numbers below 200. A stationary marker completes the rig. After a gear pattern is so far finished as to be ready for spacing, it is put in a lathe with this dial. In ten minutes a wheel of 200 teeth can be accurately spaced, much more so than if done with dividers as usual. I believe it would take a good pattern maker fully three hours to step off such a gear, especially if he failed in luck, which seems to have a great deal to do with such processes. The device mentioned is convenient and very light. George says it only cost him twenty dollars."

"By the above I am reminded of the fact that many mechanics labor under the impression that the graduations on a dial or index plate of a gear cutter are of divine origin or some such thing. The impression is wrong. Some steady-nerved and keen-sighted workman stepped off the progenitor of such devices, with spacing dividers. The question will be asked: 'Is this little dial no more accurate than one which I could space off?' I answer: Much more so. In the first place, it is very rarely that a man is found possessing the personal peculiarities which fit him for such work. But few men have them, and they have become famous. Half a dozen names would probably cover the list. Next, the small personal error of these experts has been reduced by mechanical means. All original dividing of this kind is done on large circles, say twenty feet diameter or more. The graduations on this large dial are then transferred by mechanism to a small dial, say two feet in diameter. Now the proportion of error in the two dials will be precisely the same; but it will be readily understood that an operator's liability to error will be reduced as the sizes of his divisions are increased. There are graduated circles in this country which, by laying one upon the other, will be found to coincide at each division. Shifting their relative position still shows a coincidence. This process, watched through a microscope, constitutes the test of the accuracy of a graduated circle.

"There are or have been several original circles graduated in this country. One was a heavy twenty foot wheel, spaced off long ago, at Fitchburg, Mass., I think by Mr. George Putnam, the predecessor of the Putnam Machine Company. Another was spaced at the Lowell Machine Shop, in Lowell, Mass.; but by whom I have never learned, and I have never been able to hear anything of the others."

FITTING KEYS.

"George was in my place yesterday. He showed me a method of fitting keys which, he says, is as old as the everlasting hills. I know I never heard of it before. Fig. 1 shows the method The key seats in both shaft and hub draft the same way, and the key is consequently straight. If the fit is simply neat, the thing is firmly locked. It applies especially to bevel gearing in millwork, which must back up against something; and in many cases, finding no shoulder on the shaft or convenient box near, the firmness of the hub on the shaft depends on the key entirely. Fig. 2 shows this key in such a place. It will be noticed that in one direction the gear may even be slipped by hand and the key picked out; but in the other direction everything is self-tightening. It will be a novelty to many, and, I think, of considerable value.



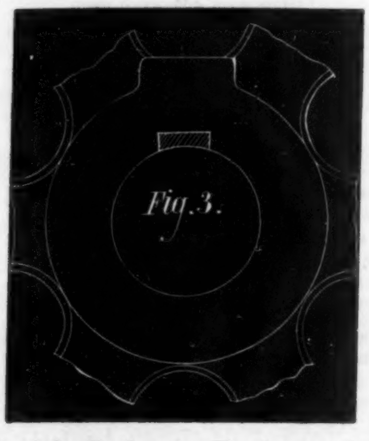
"Keys in shafting seem to be an indispensable nuisance, but they are often the only hope. I have become so disgusted with them that I never put one in where it can be dispensed with. They are all bad enough, but the taper key is the worst of the lot. The intention in these keys is to have the sides fit snug, so that they do all the work, the top and bottom or taper fit being just tight enough to prevent end motion. But I know, as others do, from vexatious experience, that it is almost impossible to get visemen

to fit these keys solid sidewise. They will invariably slack off the sides, and then waste their skill on the least important fit. Most visemen seem to think that, when they do this, they have a 'soft thing' in making the fit.

"These taper keys are miserable things anyhow, and cost $1 a lb., if properly fitted. They weaken the shaft, and cannot be made interchangeable. The all-absorbing top and bottom fit tends to split hubs, and makes a key cut and lock. Add to this latter the usual upsetting on the small end, and we have a fine mechanical contrivance.

"Where keys must be used, the proper form is parallel both ways, a neat fit on the sides, and with top clearance. A set screw bearing in the top of the key makes the arrangement firm endwise, and conveniently movable. Such keys are less expensive than taper keys, and can be made interchangeable.

"There is one form of key which possesses all the disadvantages of any taper key, but which has peculiar merits in cases where work is sent out without knowing just where the keyed fits are going to be. It requires no seat in the shaft. It will bruise a shaft enough to spoil it for a bearing, but will not weaken it. Hubs must be reinforced to stand the strain, for such keys drive by friction entirely. It does not look as though they would do the business at all, but they will. Fig. 3 shows the form. It is very much used by the



millwrights of the Northwest. The shops up there plane their keys out concave, from a steel strip. They are then cut off, and a little draft given to them. They are tempered blue. The circle of the key should be a trifle smaller than the shaft."

SETTING CALIPERS.

"Give an ordinary lathesman a pair of inside calipers (Haswell says *calibers*, and I think he is more than half right) and a six inch scale, and tell him to stand where he is and set them at 2 inches. They will be found to be about $\frac{1}{50}$ of an inch too large. Let him try it again, but with the privilege of butting one end of his scale up against something, the planed side of the tail stock of his lathe most generally; and he will get the calipers about $\frac{1}{100}$ too large. I have noticed that good, fair workmen, who have but one end of a thing to look out for, will work just about $\frac{1}{100}$ inch too large always, and many common workmen do worse The natural suggestion to my mind is that a lathesman should have a shouldered rule, one with a flange or button on one end, similar to a lumber rule. In addition a sliding sleeve, without set screw or vernier, would help him. Spring friction, holding the sleeve where set, would allow the calipers to be set by touch, and knocked into nicety, without having to hunt up the place on the scale a dozen times. Every lathesman knows that if, in adjusting his calipers, he goes too far two or three times, he begins to loose nerve and patient vision. The tool described would be a real convenience. The suggestion is made to the Providence scale men, for what it is worth,

FRENCH CALIPERS.

"Did you ever notice the ungainly caliper gages, or rules, or whatever they may be, which the refugees bring over from Alsace and Lorraine? They are big, clumsy things, about 14 inches long, and look like shoemakers' tools; but bad as they look, they are excellent contrivances. When you hire one of these refugees, he finds that we use inches, while his pet tool is graduated by centimeters; so he regretfully locks the ugly thing up for ever." LEFTWICK.

[For the Scientific American.]

GLYCERIN.

Glycerin is one of the constituents of the fixed oils and solid fats; and although discovered by Scheele nearly a century ago (1779), it is but a few years since it has become familiar to the unscientific public. The principal reason for this was that the processes of manufacture, in use until quite recently, rendered it too expensive.

Fats consist of two substances, namely, glycerin and one or more fatty acids, usually stearic and oleic; while the fixed oils are composed chiefly of oleic acid combined with glycerin. Palmitic acid is another of these fatty acids, and occurs in palm oil, in human fat, Chinese tallow, Japan wax, and several other substances. In the manufacture of soap a caustic alkali is added to the oil or fat, and at once takes possession of all the fatty acids present, forming with them stearates, oleates, and palmitates of soda or potash, as the case may be. These compounds we know as soaps, calling the former hard soap and the latter soft soap. In this operation the glycerin is liberated; and in order to separate the soap from the glycerin, salt was formerly added. The glycerin which remained in the lye after "salting out" was thrown away. In the manufacture of lead plaster, which is really a soap in which oxide of lead takes the place of potash or soda, the salting out is unnecessary, and it was in the residuary liquor that Scheele discovered glycerin. He gave it this name from its sweet taste, from the Greek word γλυκύς, sweet. For many years all the glycerin of commerce was obtained in this manner, as it was only necessary to precipitate the lead with sulphydric acid gas and evaporate the filtrate on a water bath to obtain the glycerin.

Modern chemists consider glycerin to be an alcohol, which combines with acids to form ethers. From this point of view fats and oils are compound ethers, called glycerides, and soaps are neutral salts. The chemical formula for glycerin is $C_3H_5(OH)_3$.

The extensive use that stearic acid has found, under the name of stearin, in the manufacture of candles and for other purposes has led to the invention of several new methods for its separation from the glycerin. The best of these is the one invented by our fellow countryman of sand blast fame, Mr. Tilghman. It consists in the saponification of the fats by means of superheated steam, and is largely employed in the manufacture of stearin candles, glycerin being a secondary product. The temperature most favorable to the operation lies between 550° and 600° Fah. Glycerin is purified by distillation in steam and filtration over animal charcoal. The annual production of glycerin in Europe is now 520,000 cwt.

Glycerin, as it appears in commerce, is a sirupy liquid having a specific gravity of 1·26, colorless, inodorous, sweet to the taste, and neutral to test paper. It is combustible but not so readily as ordinary alcohol. It has been frozen when exposed to a low temperature during transportation, and then melted at 45° Fah. Under ordinary circumstances it may be cooled to zero without freezing; but if a crystal of frozen glycerin be dropped into it when cooled to 20° or 21° Fah., it will all become solid. It dissolves in all proportions in water, and thus reduces its freezing point; hence Dr. Wurz proposed in 1858 to use it in gas meters, and it is now largely employed for that purpose. It also dissolves in alcohol and chloroform, but not in ether. Its solvent powers are, however, more important and interesting.

Klever has determined the solubility of forty-eight different substances, and has found that 100 parts of glycerin will dissolve 60 parts of borax, 50 parts of tannic acid, 40 parts of alum, 30 parts of sulphate of copper, 98 parts of carbonate of soda, and various quantities of the alkaloids. When bicarbonate of soda and borax are dissolved in glycerin, effervescence takes place, the carbonic acid being expelled from the former.

The uses which have already been found for glycerin are very numerous. It is frequently applied to the skin as an emollient, and administered internally as a substitute for cod liver oil. It is used as a lubricant on clocks and for delicate machinery. As it neither evaporates nor freezes, it is well adapted for floating compasses, and has been employed for thermometers. For keeping modeling clay moist, to impart to paper the peculiarity of retaining a permanently damp condition so that it may be used in taking copies of letters, to prevent inks drying too rapidly to permit of taking press copies, to prevent printers' inking rollers becoming dry and hard, for keeping photographic plates moist during long exposures, and as a solvent for gum arabic, glycerin is particularly valuable, as also in paste, cement, mortar, mastic, etc., intended for daily use. When mixed with litharge, it forms an excellent cement. Bandages for surgical purposes are treated with glycerin to render them absorbent. It is employed instead of salt for preserving untanned skins and hides. Glycerin dissolves aniline violet, alizarin, and alcoholic madder extract, hence it finds some use in dyeing. A solution of aniline colors in glycerin is often used for stamping with a hand stamp, but cannot be employed as a transparent paint on glass because of its non-drying property. The photographer finds several uses for pure glycerin, first as a test for the purity of the silver bath, secondly (as above stated) to prevent drying of the film in wet plate photography where long exposures are necessary, as in the case of interiors of rooms or shaded nooks. In combination with acetic acid it is used as a restrainer, enabling the outdoor photographer to dispense with the use of water entirely while in the field. After exposing the plate it is developed with iron as usual, and then flowed with the restrainer. At the end of the day's work the plates are taken home, where they can be fixed and finished in the usual manner. Glycerin is employed to extract the perfume from flowers and the aromatic principle of red peppers. Wine made from inferior grapes is improved and sweetened by the addition of glycerin, and an extract of malt made with glycerin is much used by brewers.

In the chemical laboratory, it is used to prevent the precipitation of the heavy metals by the alkalies. It forms the best known blowpipe test for boron in all its compounds, as was recently discovered by Mr. M. W. Iles.

Glycerin may be employed for preserving fresh fruits and meat, and if pure imparts no disagreeable flavor. It is also used instead of alcohol for preserving anatomical specimens. In pharmacy its uses are numerous and important. For disguising medicines, especially those of an oily nature, it is unequaled. It is said that castor oil mixed with an equal part of glycerin, and one or two drops of oil of cinnamon added, has been administered to physicians without their discovering that they were taking castor oil. Cod liver oil, turpentine, etc., are more easily administered when in combination with glycerin. A very little glycerin will obviate the astringent sensation produced by the chloride of iron dissolved in sirup. Carbolic acid is now generally administered in combination with glycerin, and many other acrid substances should be administered in this way. When introduced in small quantities into pills, it prevents induration and decomposition. Vaccine lymph is frequently mixed with glycerin to preserve it. Several different glycerin lotions, ointments, and plasters are described in pharmaceutical works. Sulphate of quinine dissolves in ten parts of glycerin when hot, but when cold separates in clots, which, when triturated with the supernatant liquid, gives it the consistence of a cerate, very useful for frictions and embrocations.

Another use, quite different from the above, to which glycerin is applied is the manufacture of nitroglycerin, $C_3H_5(NO_2)_3O_3$, the most powerful and dangerous explosive employed in the arts. The process of manufacture is exceedingly simple. Strong nitric and sulphuric acids are mixed together, in the proportion of two parts of the former to four of the latter by weight. Into this is poured, with constant stirring, one part by weight of pure glycerin, the temperature of the mixture being kept below 77° Fah. by external cooling with ice. When oil drops begin to form on the surface, the mixture is poured into a large quantity of cold water. The nitroglycerin then separates and is purified by washing and drying. It is a light yellow, oily liquid, inodorous, but has a sweet pungent aromatic taste, and when placed on the tongue produces a fearfully intense headache which lasts for hours.

Its explosive properties are already too well known from the numerous fatal accidents that have recently attended its use hereabouts, to say nothing of the Bremerhaven explosion.

The complex nature of the glycerin molecule renders it peculiarly susceptible to the action of reagents; it readily forms other substitution compounds, and is general a dangerous substance to experiment with. A warm concentrated solution of permanganate of potash poured into glycerin decomposes it with explosive violence; chromic acid and glycerin are likewise explosive, facts which should be remembered when putting up prescriptions containing glycerin.

E. J. H.

A Materialized Hole.

Take a sheet of stiff writing paper and fold it into a tube an inch in diameter. Apply it to the right eye and look steadfastly through it, focussing the eye on any convenient object; keep the left eye open. Now place the left hand, held palm upward, edgeways against the side of the paper tube, and about an inch or two above its lower end. The astonishing effect will be produced of a hole, apparently of the size of the cross section of the tube, made through the left hand. This is the hole in which we propose to materialize another and smaller hole. As we need a genuine aperture, and it would be inconvenient to make one in the left hand, let a sheet of white paper be substituted therefor and similarly held. Just at the part of the paper where the hole equaling in diameter the orifice of the tube appears, make an opening ½ inch in diameter. Now stare intently into the tube; and the second hole, defined by its difference of illumination, will be seen floating in the first hole, and yet both will be transparent. The illusion, for of course it is one of those odd pranks our binocular vision plays upon us, is certainly one of the most curious ever devised. Besides, here is the actual hole clearly visible, and yet there is no solid body to be seen to define its edges. It is not a mere spot of light, because, if a page of print be regarded, the lines within the boundaries of the little hole will not coincide at all with those surrounding it and extending to the edges of the large apparent aperture. Each eye obviously transmits an entirely different impression to the brain, and that organ, unable to disentangle them, lands us in the palpable absurdity of a materialized hole.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From August 11 to September 11, 1876, inclusive.

AIR BRAKE, ETC.—C. A. Bonton (of New York city), London, England.
ALARM PUNCH.—J H. Small, Buffalo, N. Y.
BENDING WIRE, ETC.—H. W. Putnam, Bennington, Vt.
BOILER CIRCULATOR.—B. S. Koll, Pitsburgh, Pa.
BOOT-SEWING MACHINE.—G. McKay, Boston, Mass.
BOOT-SEWING MACHINE.—J. Cutlan, Philadelphia, Pa.
CARPET LINING, ETC.—O. Long, Brooklyn, N. Y., *et al.*
COTTON OPENER, ETC.—S. D. Keene, Providence, R. I.
CRUSHING QUARTZ, ETC.—D. D. Mallory, Mystic Bridge, Conn.
DRESSING BRISTLES, ETC.—E. B. Whiting, St. Albans, Vt.
FENCE, ETC.—L. E. Evans, New York city.
FLOOR COVERING.—J. F. Gloyn, Astoria, N. Y.
FURNACE.—A. L. Holley, Brooklyn, N. Y.
GAS GOVERNOR.—R. H. Plass, New York city.
GLOVE FASTENER.—J. Lewine, New York city.
HYDRAULIC ELEVATOR, ETC.—T. Stebins *et al.*, Boston, Mass.
KNIFE HANDLE.—J. W. Gardner, Shelburne, Mass.
KNITTING MACHINERY.—J. L. Brown, Chicago, Ill.
MAKING STEEL, ETC.—H. Schierloh, Jersey City, N. J.
MUSICAL INSTRUMENT.—C. F. Hill, Stamford, Conn.
PREVENTING SMOKE,—J. Todd, Potosi, Mo.
PRINTING TELEGRAPH —G. M. Phelps, Brooklyn, N. Y.
PUNCH.—D. L. Kennedy *et al.*, New York city.
RAILWAY.—E. E. Lewis, Geneva, N. Y.
RAILWAY SIGNALS, ETC.—F. W. Brierley, Philadelphia, Pa.
RAILROAD TIE.—G. D. Blaisdell, Cambridge, Vt.
RAISING BLINDS, ETC.—L. H. Gano, New York city.
RIVETING MACHINE, ETC.—J. F. Allen, New York city.
ROTARY BOILER.—C. W. Pierce, New York city.
SEWING LEATHER, ETC.—E. R. Gardner, New Bedford, Mass.
SEWING LEATHER, ETC.—G. V. Sheffield *et al.*, Brooklyn, N. Y.
SEWING MACHINE.—H. P. Garland (San Francisco, Cal.), Dundee, Scotland
SMOOTHING PLANE.—C. E. Smith, Crawfordsville, Ga.
SPINNING MACHINERY.—J. Goulding, Massachusetts.
STEAM ENGINE.—G. B. Massey *et al.*, New York city.
VELOCIPEDE.—S. Gilzinger, Rondout, N. Y.

NEW BOOKS AND PUBLICATIONS.

THE CITY OF HOLYOKE, its Water Power, and its Industries. Holyoke, Mass.: Holyoke Manufacturers' Association.

We have received a superbly printed and copiously illustrated sheet bearing the above title, and designed to exhibit the industrial advantages offered by the water power system of Holyoke, Mass. By means of a gigantic dam, constructed at the rapids of the Connecticut river, a total power equal to 30,000 horse power is rendered available, and fractional portions of this are sold with mill sites. Those of our readers who may desire detailed information regarding this exceptionally favored locality would do well to send to the Holyoke Manufacturers' Association for a copy of the above named paper. The illustrations are admirably executed, and give an excellent idea of the extent of the city and its industries.

THE INVENTION OF PRINTING. By T. L. De Vinne. New York city: Francis Hart & Co., 12 College Place.

We have already reviewed the scope of this book in some detail, and need only here state that the portions as they appear fully bear out the promises of excellence made in the beginning. Paper and printing are alike admirable, the illustrations are selected from ancient sources with great discrimination, and the entire contents of the volume thus far published bear the marks of deep research into, and a thorough knowledge of, its fascinating subject. The book is one not merely valuable to the craft, but deserves a prominent place in the library of every student of the world's progress.

Recent American and Foreign Patents.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED SCREW PROPELLER.

Joseph G. Hill, Newark, N. J.—This is a contrivance for constructing the hub in sections, so as to attach blades of rolled plate; and it also consists of a propeller blade in half or a lesser portion of a circle, and shaped in a true flat plane, instead of the spiral shape heretofore employed, whereby it is believed that better results can be obtained than from the spiral form.

IMPROVED TURBINE WATER WHEEL.

Edward Derby, Ridgway, Pa.—The object here is to utilize the entire force of the water, and at the same time balance the thrust upon the shaft, and thus diminish friction. Two direct action wheels and a central reaction wheel are combined with the shaft and case, and the case is suitably constructed to adapt it for use with the triple wheel.

IMPROVED LABELING MACHINE.

George H. Burrows, Boston, Mass.—This relates to apparatus for labeling packages; and it consists of a combination of levers, worked by suitable gearing, and paste rollers and paste troughs, in such a way that, by moving a hand lever, the rollers charged with paste are thrown out of the paste troughs on the ends of the label and back again into the troughs. It also consists of a platform carrying the labels, which is counterbalanced by a weight in such a way that the pile of labels placed on the platform is always held by the counterbalance against a retaining lip, so that the upper label in the pile is always at a given point. It further consists of a guard thrown over the free end of the label by the action of one of the paste rollers.

IMPROVED BRAKES FOR FIRE TRUCKS AND WAGONS.

Minford S. Clark, Brooklyn, N. Y.—The first invention is an improved brake for fire trucks, that is worked by the attendant at the steering wheel. The mechanism swings in supporting arms of the fifth or steering wheel at the hind part of the truck, and is operated by intermediate crank shafts and rods, by a fulcrumed treadle from the seat of the attendant. The motion-transmitting crank shafts are swung in bearings of the fifth wheel and of the truck frame, and connected by a swivel chain. In the second invention, a forked and spring-acted lever is worked by swivel chain, crank lever connection, and treadle, from the driver's seat, to engage the tongue and prevent its backward motion when it is desired to back the vehicle.

IMPROVED PUMP.

William H. Pollard, Seneca Falls, N. Y., assignor to Gould Manufacturing Company, of same place.—The object is to provide for vessels a pump which is attached to a stationary suction pipe, extending down to the bottom of the hold of the vessel, so as to be used as a bilge pump, for removing any water which may collect in the bilges from leaks or any other cause. By means of some small changes the pump may also be used as a force pump. The invention consists, first, of the construction of the cylinder heads and supports in one piece, so as to raise the lower part of the pump, to admit the ready dropping of the bed plate for getting at the lower valves; secondly, of the combination with the suction opening of a T joint, that may be connected to the stationary suction pipe, or to a detachable sleeve to connect with an overboard suction pipe, and, lastly, of the combination of the discharge opening, with an attachment to which a hose may be applied, for using the pump as a hand fire engine.

IMPROVED DIAMOND MILLSTONE-DRESSING MACHINE.

Aaron C. Fry, Keedysville, Md.—In this invention the diamond tool is set in a vertical holder, attached to a carriage sliding longitudinally in a vertically adjustable main frame. The tool is raised and lowered by a vertical screw, commanded by a gear wheel sliding lever and spring pawl, with an adjustable gage attached to regulate their operation. The tool is adjusted laterally by means of a transverse screw, acting upon the tool holder, to which screw motion is communicated by gearing, driven by a vibrating lever having a reversible detent attached, and which, as the carriage slides back, strikes and slips over an adjustable bar fixed to the rear of the main frame; thus, by means of the gearing and transverse screw moving the tool laterally, more or less, according to the adjustment of the bar fixed to the main frame.

IMPROVED STEAM HAMMER.

William Walker, Manchester, England.—This invention consists in connecting the trip of the hammer and the spindle by a series of levers, links, and connecting rods, whereby the steam and exhaust parts may be opened and closed automatically. A dropping lever, immediately connected with the trip of the hammer, serves by its unchecked momentum (which is communicated to the valve spindle) to open the lower steam port immediately after the blow of the hammer is delivered, thus securing a dead blow, while a small projection on the trip of the hammer serves to open gradually the upper steam port as the hammer ascends.

IMPROVED CAR COUPLING.

Robert K. Welch, Philadelphia, Pa.—The end of the drawhead is made of U shape, the outermost ends being provided with inwardly projecting hooks that interlock with spring-acted coupling hooks at the end of the adjoining car. The spring hooks are fulcrumed to a casing bolted to the car frame, and forced to be outside by a spiral spring. The rear ends of the spring hooks are acted upon by an inverted cone that is keyed to a screw spindle, so as to force, when turned down by a suitable key, the rear ends of the spring hooks to the outside, and cause the front ends to approach each other until they release the interlocking hooks of the drawhead. By turning the spindle and cone back, the spring hooks assume their former position, ready to couple automatically with the drawhead when the cars approach each other.

IMPROVED SUCKER ROD EXTRACTOR.

George M. Sheffer, Emlenton, Pa.—This is an improved device for extracting sucker rods from bore holes of wells, etc.; and it consists of a spring, with toothed jaws that slide in the socket part of the extractor and bite the rod when properly applied, so as to raise the same.

IMPROVED GRATE BAR.

Lucien H. Allen and William Barton, Tamaqua, Pa.—This consists of a grate bar made of a longitudinal bearing bar and curved crossbars or ribs at both sides, which extend from the upper part of the bearing bar. The cross bars at one side alternate in breaking joints with those at the other sides.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED CHILDREN'S CARRIAGE.

Charles W. Carter, Terre Haute, Ind., and Everett E. Fox, Isle St. George, Ohio, said Carter assignor to said Fox.—This carriage is so constructed that the wheels may be turned down into a horizontal position to adapt it for use as a crib. It may also be adjusted to have greater or less elasticity.

IMPROVED CHIMNEY.

George F. Knight, Carroll, Ohio.—This invention relates to certain improvements in chimneys, designed for the better ventilation of the rooms, and the rendering of the same fireproof by providing for the easy removal of soot, and arresting the issue of sparks. It belongs to that class of chimneys which have an inner and an outer flue; and it consists in combining with the same a deflector of peculiar construction, which diverts the soot from the inner smoke flue to the outer flue, down which it falls into a removable pan at the bottom, a cage of perforated sheet metal being arranged at the top to operate as an additional security against the issue of sparks.

IMPROVED SLEEPING CAR.

Gustave Leve, Montreal, Quebec, Canada.—This invention consists in the frames, divided into two compartments by a central partition, and hinged to the side walls of a car in such a way that they may be swung in against said walls, or swung out at right angles with them. The berths may be placed in a vertical position within said frames, or turned down into a horizontal position between two adjacent frames. In the car floor are recesses at right angles with the side walls, to receive the lower ends of the hinged frames when said frames are swung outward.

IMPROVED DRAFT ATTACHMENT.

Justus P. Luther, Harrison D. Chemberlin, and Nelson De Groff, Berlin, Wis.—This device is intended to equalize the draft and steer the wagon, so as to do away with the movement of the tongue when one wheel strikes a stone. This is obtained by the leverage secured through the difference in distance from draft bolt to arms, and arms to slot. The forward end of the drawbar, being loose, is drawn toward the obstructed wheel, and the bar is caused to slide on a pin, thereby loosening the chain on the opposite side from the wheel obstructed, and giving a quartering draft to the team. This throws the direct draft of both horses upon the wheel obstructed, and lifts it over the obstruction.

IMPROVED CAR WHEEL.

Louis Le May, Hudson, N. Y.—This is an improved construction of feathered car wheels; and it consists in a car wheel in which the tire is connected to the hub, and supported by a radial spring web on the hub and tire. The hub is made of a flanged section and a removable ring section, secured by connecting bolts. This is claimed to afford a wheel of considerable strength and rigidity, but of sufficient elasticity.

NEW HOUSEHOLD INVENTIONS.

IMPROVED WASHING MACHINE.

Chester Allen, Corinth, N. Y.—In using the machine, a cylinder is rolled back and forth upon the clothes spread upon a bed rack, the water is pushed before it, flows through the holes in the end boards, passes down into the channel below the bed rack, and rises through the spaces between the cross bars before and behind the cylinder. The clothes are thus lifted from the rack, and moved so that they will be operated upon each time in a different place.

IMPROVED SADIRON HEATER.

Preston H. Sessoms and Josiah Mizell, Coleraine, N. C.—This invention consists in attaching a sadiron receptacle to the top of a combustion chamber, with its rear end formed into a flue. The combustion chamber rests upon a frame which stands over and around a lamp or other suitable heating apparatus, both frame and enclosed lamp being supported by a base plate.

IMPROVED DOOR CHECK.

James Peirce, Nora, Ill.—This consists in a spring latch attached to the base board or wall, combined with a catch and buffer that is attached to the door, so arranged that it may act as a latch and buffer combined, or as a latch alone.

IMPROVED SADIRON HEATER.

William H. Haylock, Jonesville, assignor to himself and Charles S. Pierson, Sandy Hill, N. Y.—This invention consists in combining in a sadiron heater a lamp, having diametrically opposite pins, with a ring of the leg frame. There is also a burner, provided with a partition, so that each flame will have its own separate draft or current of air.

IMPROVED FOLDING CHAIR.

Thomas M. Wyatt, Russelville, Ark.—This is an improved folding chair, designed especially for dentists. To fold the chair, the back is turned down upon the seat, the seat is closed up, the front legs are turned back between the back legs and turned up against the back, and the back legs are turned up in front, folding the chair very compactly. There is a new lateral and vertical adjustment of the head rest. A greater variety of position is obtained through the rest bar adjusting almost automatically at any desired angle.

IMPROVED GRIDIRON.

George Cornwall, Garden City, N. Y.—This consists of a close corrugated plate for supporting the meat on the upper angles of the corrugations. To this plate are applied flanges extending down from the sides and back to rest on the stove top. The space under the plate has a trough for receiving the gravy. The close plate protects the meat from the flame and smoke, and cooks the meat better by checking the intensity of the heat.

IMPROVED CLOTHES PIN.

Uriah D. Mihills, Fond Du Lac, Wis.—This consists of a clothes pin with a notched wooden cross key secured to the head of the pin. The key serves as a handle for the pin, and allows it to be brought close to the line, to prevent, by its rigid position thereon, the chafing of the clothes by the points. The projecting parts of the key also allow the pin to be more easily removed.

IMPROVED PROTECTOR FOR CHANDELIERS.

Frank J. Symmes, San Francisco, Cal.—This is composed of mica plates and a metal contrivance for suspending the device. It is so contrived as to protect the gaselier from the heat, and from the deposit which collects upon metal deflectors.

NEW MISCELLANEOUS INVENTIONS.

IMPROVED CLASP.

Alva M. Butler, Constantine, Mich.—This is a clasp for fastening cigar boxes, etc. It is bent at right angles to fit upon the edge of a box, and has points formed upon its end parts, to enter the cover and side of said box.

IMPROVED JOINT OF PIANO ACTION.

Frank Preston, Elgin, Ill.—This consists of a pivot pin for the hammer, pointed at each end and fitted in a bush having a conical seat and screwed into the bearings, in which it was held firmly by a clamp contrivance to prevent it from turning after being adjusted. The object is to provide a joint that cannot be affected by dampness.

IMPROVED SURVEYING INSTRUMENT.

Matthew W. Venable, King's Mountain, Ky.—It is not possible to explain the construction of this instrument without drawings. It is, however, a surveyor's telescope, which may be used for setting slope stakes in a rapid manner on inclined, rough, or broken ground. It also may be used for finding the gradient between two given points, and by simple modifications may serve as a clinometer level. For railroad engineers, it appears to be a useful instrument.

IMPROVED SPINNING TOP.

Andrew Kern, Utica, N. Y.—The invention consists of a tubular handle on the upper part of the spindle of the top, within which the string for spinning the top is attached to the spindle. The handle allows the top to be held in the hand, after it has been set running, to be set down in any required place.

IMPROVED HAIR-PUFFING PIN.

Annis Hurd, Waterloo, Iowa.—This is a puffing pin with clasping spring legs and connecting spring coil, the sections of which are arranged slantingly to each other for passing a hair pin readily through either coil section.

IMPROVED FLAG SIGNALING APPARATUS.

Rufus D. Couch and Jesse M. Lamb, Sharpville, Ind.—The object of this invention is to enable the telegraph operator to signal all approaching railway trains without leaving his office, by a signal flag, which is unwound from a spring roller by a cord, and arranged in a suitable frame in conspicuous position. On releasing the cord the spring roller acts to rewind the flag.

NEW AGRICULTURAL INVENTIONS.

ROTARY SPADER, STALK CUTTER, AND FIELD ROLLER.

Peter D. Pelsor and Henry C. Pelsor, Metamora, Ind.—In the face of a large roller are formed rows of slots of such a size that the spades may fit into them, so that all the dirt that may adhere to the said spades may be scraped off every time they are drawn inward. There are devices for removing the spades or cutters; also for preventing them from getting out of place while holding them back, thus adapting the machine to be used as a field roller and enabling it to be readily drawn from place to place.

IMPROVED STUMP PULLER.

Chester C. Adams, Decatur, Mich.—By alternately driving a team of horses forward and backing them up, a succession of impulses is given to a shaft, winding the rope or chain around it and drawing the stump. The shaft is mounted in a frame and has a ratchet. The power is applied to a lever, on which is a pawl which engages with the ratchet.

IMPROVED FERTILIZER DISTRIBUTER.

Pleasant P. Linder, Alexandria, Ala.—The novel feature in this implement is a block fitted to slide on the axle, in order to act in conjunction with a slide in regulating the discharge of manure in different states of comminution.

IMPROVED PLOW.

Melvin P. Sparks, Spring Lake, Mich.—This plow embodies a new mechanical construction, which is claimed to lessen the friction against the bottom and landside of the furrow, to enable the plow to be more easily thrown out of the ground, and to work at any desired depth in or to run above the ground, and to be of lighter draft.

IMPROVED GRAIN BAND.

John H. Swihart, Upshur, Ohio.—This is a simple and ingenious little device, consisting of a wire pointed about midway its length and attached to a small plate at one end. There is a hole in the plate to receive the other end of the wire when the band is being passed around the sheaf. When the binder is released, the pressure of the bundle upon the inner end of the plate brings the said plate into an inclined position with and causes it to bind upon the wire.

IMPROVED REVOLVING GARDEN AND FIELD HOE.

David B. Sherman, Castleton, Vt.—Two side boards are connected by a board attached to their forward ends, and by a board attached to the upper edges of their rear ends. Between the side boards is pivoted a roller, to which are attached the shanks of a number of small hoes. The machine is propelled by handles attached to the side boards.

IMPROVED HARROW.

Jesse G. Stokesbary and John H. Stokesbary, Millersburg, Iowa.—This harrow embodies five new mechanical devices, which enable it to be adjusted for use as a large or as a small harrow, to be cleared of rubbish without stopping the team, and to be used for any kind of harrowing, and upon any kind of ground.

IMPROVED PLOW.

Swan N. Cedarland, Solomon Rapids, Kan.—The new feature is a flat plowshare having an angular front edge, and a cutter attached to the side thereof, the point or apex of said angle being nearer the cutter than the opposite side of the share. This tends to draw the plow into the ground.

IMPROVED COMBINED CULTIVATOR AND HARROW.

John R. Dunlap, Sherman, Ill.—By suitable construction, this implement may be guided to follow the row, however crooked it may be, the resistance of the soil against the cutters being sufficient to draw the harrow after them. By bearing down upon the rear end of a lever, the forward end of the harrow is raised from the ground, allowing any rubbish that may be caught upon the harrow teeth and the plows to drop off. The plows may be relatively adjusted as desired.

IMPROVED COMBINED PLANTER, CULTIVATOR, AND MARKER.

Joseph K. Kelly, Algonquin, Ill.—Four novel mechanical devices are here embodied, producing a machine that may be readily adjusted for use for marking off land for planting the seed, and for cultivating the plants. By an improved construction, the rubbers prevent the kernels from being injured by the movements of the dropping slides.

Business and Personal.

The Charge for Insertion under this head is One Dollar a Line for each insertion. If the Notice exceeds Four Lines, One Dollar and a Half per Line will be charged.

Notes & Queries

It has been our custom for thirty years past to devote a considerable space to the answering of questions by correspondents; so useful have these labors proved that the SCIENTIFIC AMERICAN office has become the factotum, or headquarters to which everybody sends, who wants special information upon any particular subject. So large is the number of our correspondents, so wide the range of their inquiries, so desirous are we to meet their wants and supply correct information, that we are obliged to employ the constant assistance of a considerable staff of experienced writers, who have the requisite knowledge or access to the latest and best sources of information. For example, questions relating to steam engines, boilers, boats, locomotives, railways, etc., are considered and answered by a professional engineer of distinguished ability and extensive practical experience. Enquiries relating to electricity are answered by one of the most able and prominent practical electricians in this country. Astronomical queries by a practical astronomer. Chemical enquiries by one of our most eminent and experienced professors of chemistry; and so on through all the various departments. In this way we are enabled to answer the thousands of questions and furnish the large mass of information which these correspondence columns present. The large number of questions sent—they pour in upon us from all parts of the world—renders it impossible for us to publish all. The editor selects from the mass those that he thinks most likely to be of general interest to the readers of the SCIENTIFIC AMERICAN. These, with the replies, are printed; the remainder go into the waste basket. Many of the rejected questions are of a primitive or personal nature, which should be answered by mail; in fact hundreds of correspondents desire a special reply by post, but very few of them are thoughtful enough to enclose so much as a postage stamp. We could in many cases send a brief reply by mail if the writer were to enclose a small fee, a dollar or more, according to the nature or importance of the case. When we cannot furnish the information, the money is promptly returned to the sender.

W. L. L. will find a good recipe for aquarium cement on p. 80, vol. 31. To blacken a brass microscope tube, see p. 362, vol. 25.—C. C. C. will find an explanation of duplex telegraphy on p. 235, vol. 34.—A. B. C. will find directions for browning gun barrels on p. 11, vol. 32.—A. S. should read the directions for constructing the simple battery again.—P. M. and W. M. will find directions for nickel plating cast iron and steel on p. 186, vol. 34.—C. W. T. can etch glass with hydrofluoric acid. See p. 409, vol. 31.—O. A. Jr. should read our article on the horse power of engines on p. 33, vol. 33.—C. L. P. can solder the parts of his brass oil tank together. See p. 251, vol. 28.—A. P. P. will find a recipe for a depilatory on p. 186, vol. 34.—O. J. will find a recipe for a gold solder on p. 251, vol. 28.—M. G. will find directions for making vinegar on p. 106, vol. 32.—A. R. will find full particulars of the New York canal steamer reward on pp. 288, 295, vol. 24.—H. H. can get rid of roaches and bugs by using the remedy described on p. 315, vol. 32.—G. Z. will find a recipe for a cement for joining stone, etc., on p. 251, vol. 31.—F. H. W. will find directions for lighting gas by electricity on p. 4, vol. 29.—M. will find instructions for annealing steel castings on p. 298, vol. 24.—B. will find directions for removing fruit stains from ivory on p. 10, vol. 32.—E. S. R. is assured that the pretensions of the divining rod men, for discovering water, precious metals, etc., in the earth, are all humbug.—E. B. W. will find an answer to his query as to the sinking of a body in deep water on p. 208, vol. 33.—F. C. can keep small steel articles from rusting by the method described on p. 169, vol. 33.—A. K. J. will find an article on the artificial production of cold on p. 351, vol. 34.—G. C. M. can find the power of his spring only by experiment.—F. A. P. will find directions for bronzing on iron on p. 283, vol. 31. For bronzing on brass, see p. 51, vol. 33.—Will D. W. A., of Atlanta, Ga., send us his name?—J. M. should consult a physician as to the feet troubles.—B. M. E. will find a good recipe for indelible ink on p. 129, vol. 28.—W. H. R. is informed that the shellac and alcohol preparation he mentions is French polish. See p. 11, vol. 32.—J. J. D. B. will find a recipe for a black walnut stain on p. 90, vol. 32.—D. W. D. will find a recipe for a paint for outdoor work on cement on p. 277, vol. 26.—W. T. B. will find directions for building an ice house on p. 251, vol. 31.—A. E. R. will find a description of malleable cast iron on p. 138, vol. 29.—M. G. will find an excellent article on the nature of heat on p. 325, vol. 33.—T. A. should keep the brass work on his locomotive bright by the method described on p. 102, vol. 25.—T. W. F. should put nitric acid in the porous, and salt water in the glass, cell of his battery.—L. J. W. will find directions for gilding wood on p. 90, vol. 30.—E. H. F. will find a recipe for waterproofing canvas on p. 347, vol. 31.—L. H. will find directions for building an icehouse on p. 251, vol. 31.—J. P. can attach leather to his iron pulleys by following the directions on p. 409, vol. 33.—S. A. H. can prevent the accumulation of rust on his tools by following the directions on p. 169, vol. 33.—T. S. D. will find directions for preserving birds on p. 159, vol. 32.—L. F. L. will find a recipe for bronze on brass on p. 51, vol. 33. For bronze on iron, see p. 283, vol. 31.—D. T. W. will find a recipe for indelible ink on p. 129, vol. 28.—L. D., F. P., J. H., W. S. C., J. B. H., E. G. A., G. C. M., O. H. B., R. J., H. A. M., and many others, who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) P. says: In the SCIENTIFIC AMERICAN SUPPLEMENT, August 5, No. 32, you give very minute drawings of a boiler and engine for a navy cutter, with size of boat, etc. What speed would a boat, built with such proportions, etc., attain? A. If the boat has a good model, it should attain a speed of 8½ or 9 miles an hour, in smooth water.

(2) J. A. B. says: 1. In your issue of August 9 you state that the improved Holtz electric machine has two plates that revolve in opposite directions. You tell how the collecting arms are placed, but I do not understand how the sectors are placed. What is the diameter of the plates in the best machines? Should they be of plate glass, or will the best window glass do as well? What should be the thickness of the glass to give the best effects? What published work gives the best exposition of the Holtz machine? A. You will find a full statement of the machine in Dechanel's "Natural Philosophy," which is now published in parts. Get the part on electricity and magnetism.

(3) A. S. asks: How large a vertical boiler will be needed to run two engines 8x8 inches, the boiler having plenty of heating surface, and the engines running with 100 lbs. steam? A. Make one 4½ to 5 feet in diameter and 7 feet high.

(4) A. G. W. asks: 1. How many revolutions should a 13 inch bottom runner corn mill make to give best results in quantity and quality of meal? A. From 800 to 900 a minute. 2. How much can it grind per hour with an eight horse power engine? A. From 10 to 12 bushels. 3. I wish to run a 50 saw cotton gin at the same time with the corn mill. Can the mill grind as much under such conditions as it could when I throw the gin off? A. Probably the gin will make a difference of 2 or 3 bushels an hour.

(5) F. C. says: We have a boiler that does not steam very well. The heat passes under, then back through the tubes, then over and under the top. Will turning the air from a blacksmith's fan underneath the fire make the fire burn more strongly, or should we pass it through above the fire? A. If the trouble is lack of draft, the first plan will doubtless prove serviceable.

(6) W. S. asks: What is the greatest depth of water explored with a diving bell? A. We have seen an account of a diver working at a depth of about 160 feet. Perhaps some of our readers may know of instances in which still greater depths have been reached. In the use of either the bell or diver's suit, weights are attached to make the apparatus sink, and air is forced into the interior through a flexible tube.

(7) K. W. D. says: A man weighing 200 lbs. is hung. Would a keg of nails weighing 200 lbs. exert more strain on the rope than the man, the drop being 3 feet? A. Possibly it might, being less elastic.

(8) R. W. H. says: We have a coal shaft 320 feet deep, which has a pump in the bottom: and the steam is furnished from the surface of the ground, and the pipes, both water and steam, are rusted out very fast by the water that runs down the shaft. It is salt water. Can you tell us of a remedy? A. The surest remedy would be the use of copper pipes.

(9) J. S. Jr. asks: How can I separate white lead from tallow or oil? A. Remove the oil and grease by treating with bisulphide of carbon.

(10) H. J. M. asks: 1. Is the bulk of the starch used made from corn? A. No: the greater part is made from potatoes, rice, and wheat. 2. What is the process of making starch from corn? A. The crushed grain is macerated with a weak soda lye, which dissolves the gluten and leaves the starch. 3. What percentage of starch does corn contain? A. American corn contains 50 or 60 per cent of starch. 4. Does it require a large amount of machinery and capital to engage in this business? A. Yes.

(11) H. E. asks: What can I apply to the inner surface of a hogshead to protect the wood from the action of the chloride of sodium, commonly called Javelle water? A. You probably mean the hypochlorite of sodium (*eau Javelle*). Try coating the interior of the casks with melted paraffin.

(12) H. A. S. says: 1. Which of the elements may be volatilized so as to be detected by the spectroscope in a hydrogen flame? A. Potassium, sodium, barium, strontium, and other metals forming, with oxygen, alkalies and alkaline earths. 2. Which may be detected in an oxyhydrogen flame? A. All the metals and many of the other elements, but not so well as with the electric lamp. 3. Which may be detected in the electric sparks of different lengths? A. All the elements—the metals, the gases, and the vapors of the non-metallic elements.

(13) C. C. R. says: I have some printer's ink that takes from 24 to 36 hours to dry. Can you tell me of anything that will make it dry more quickly? A. We understand that finely powdered permanganate of potassa, introduced in small quantities, is admirably suited for this purpose.

(14) J. W. W. says: Boerrhave asserts that, by putting alcohol into an ox bladder and exposing it to the sun, he produced absolute alcohol by exosmose. Donovan disbelieves it. Who is correct? A. Absolute alcohol cannot be obtained by such a method. 2. Do whisky, brandy, and gin lose or gain in strength after they are first made? A. This depends altogether upon what condition the liquors are in when bottled. If properly prepared they seldom lose in strength.

(15) A. D. S. says: I have seen Brussels carpets scrubbed with soap and water, in which was put something that brightened the colors in the oldest carpets. Can you tell me what was used for this purpose? A. It was probably carbonate of soda or potash.

(16) J. T. S. asks: 1. What must I do to make common printing ink copyable? A. We do not think that this has ever been satisfactorily accomplished. 2. Can type metal be soldered to brass with common plumber's solder? A. Yes.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

J. S. H.—It appears to be a piece of iron slag. It is not of meteoric origin.—S. J., Frostburg, Md.—The samples became separated from the letter, and, as they were not properly marked, were lost.—M. P. T.—It is fire clay.—S. C.—No. 1 is limestone. No. 2 is felspar.—A. B.—The red rock is massive iron garnet. The other is a species of hornblende.—T. W.—The clay is of a fine quality, but does contain a small quantity of iron; otherwise it is nearly pure.—W. H. G.—It is white sulphide of iron (marcasite).—E. C.—The yellow bodies consist of clay colored by oxide of iron (yellow ocher). The dark variety might be employed as a fire clay, and for making cheap drain pipes and pottery. The other specimens are kaolin, of different grades of purity.—C. S.—It is hornblende.—W. E. D.—The water contains an injurious amount of organic matter.—M. R. H.—No. 1 is sulphide of iron and quartz.—No. 2 is quartz and mica schist. No. 3 is slate.—G. J.—No. 1 is Amazon stone, a species of orthoclase. No. 2 is yellow jasper. No. 3 is red jasper. No. 4 contains lead and silver. No 5 is smoky quartz. No. 6 is hornblende and sulphide of iron.—No. 7 is hornblende, felspar, and carbonate of copper.—R. H. F.—It is an impure clay, a silicate of alumina.—A. B. O.—The water contains a large quantity of sulphides and organic matter. It has been contaminated by contact by the cork and camphor, which the bottle previously contained.—J. H. S.—No. 1 is shale. No. 2 is sandstone containing considerable iron pyrites.—L. B. C.—The sample does not contain nickel.—J. G. W.—It is an impure clay containing small specks of iron pyrites. In order to classify the shells, it would be necessary to have more of them.—G. W. W., who asked about new nickel electrolyte, does not state what his trouble was. The ammonia used was possibly not strong enough. The bath is simply a solution of cyanide of nickel in ammonia.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Hydrophobia. By L. M. N.
On Advancing Science. By N. M. R.
On Salicylic Acid. By W. E. F.

Also inquiries and answers from the following:

H. T.—J. R.—B. L.—J. H.—J. A.—T. W.—C. W.—A. N.—A. W.—W. H. F.—M. B.—J. M.—C. A, M.—R. N.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "How can I find a partner with $5,000 capital? Who sells model steam engines? Who makes the best truss, for the relief of hernia? Who makes plate glass show cases? Who sells fireproof safes? Who sells sewing machine attachments at wholesale?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal." which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

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FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

September 12, 1876,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city.

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DESIGNS PATENTED.

9,491.—STOVES.—A. C. Barstow, Providence, R. I.
9,492.—BELT.—C. F. Brigham, Worcester, Mass.
9,493.—MUFF.—B. Lüddecke, New York city.
9,494.—IRON FENCE.—J. B. Wickersham, Philadelphia, Pa.
9,495.—BOTTLES.—G. W. Shedd, Jr., Boston, Mass.

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